Little Luckiamute River Watershed Work Plan

POLK COUNTY, OREGON

OCTOBER 1971

Prepared under the authority of the Watershed Protection & Flood Prevention Act (Public law 566, 83rd. Congress, 68 Stat. 666) as amended.

USDA-SCS-PORTLAND, OREG. 1971

Watershed Work Plan
Little Luckiamute River Watershed

Polk County, Oregon

Prepared under the Authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended.

Prepared by: Polk Soil and Water Conservation District
Little Luckiamute Water Control District
Polk County
City of Monmouth

with assistance by:

U. S. Department of Agriculture
Soil Conservation Service
Forest Service

October 1971

COVER PICTURE: As the Little Luckiamute River flows into Falls City, it plunges over a forty foot high cascade in its flow downstream to the Luckiamute River.

SCS PHOTO ORC-235-5

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POLK COUNTY, OREGON

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WATERSHED WORK PLAN AGREEMENT

Between the

POLK SOIL AND WATER CONSERVATION DISTRICT

POLK COUNTY

LITTLE LUCKIAMUTE WATER CONTROL DISTRICT

CITY OF MONMOUTH

(hereinafter referred to as the Sponsoring Local Organizations)

State of Oregon

and the

SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organizations for assistance in preparing a plan for works of improvement for the Little Luckiamute Watershed, State of Oregon, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666) as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service a mutually satisfactory plan for works of improvement for the Little Luckiamute River Watershed, State of Oregon, hereinafter referred to as the watershed work plan, which plan is annexed and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organizations and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about six years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. Except as otherwise provided herein, the Sponsoring Local Organizations will acquire without cost to the Federal Government such land rights as will be needed in connection with the works of improvement and provide documentary evidence of these acquisitions (estimated cost $894,580). The percentages of this cost to be borne by the Sponsoring Local Organizations and the Service are as follows:

Works of Improvement	Sponsoring Local Org. (Percent)	Service (Percent)	Estimated Cost (Dollars)
Teal Creek Multiple Purpose Reservoir			
Payment to landowners for about 600 acres	58.33	41.67	335,000
Cost of relocation or modification of improvements	58.33	41.67	121,000
Legal fees, surveying, and other related costs	100.00	0.00	45,600
Teal Creek Reservoir Recreational Facilities			
Payment to landowners for about 258 acres	50.00	50.00	154,800
Legal fees, surveying, and other related costs	100.00	0.00	15,480
All Other Structural Measures	100.00	0.00	222,700

The Sponsoring Local Organizations agree that all land acquired or improved with P. L. 566 financial or credit assistance will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement.

2. The Sponsoring Local Organization will provide relocation advisory assistance services and make the relocation payments to displaced persons as required by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84

Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. Prior to July 1, 1972, the Sponsoring Local Organization will comply with the real property acquisition policies contained in said Act and Regulations to the extent that they are legally able to do so in accordance with their State law. After July 1, 1972, the real property acquisition policies contained in said Act shall be followed in all cases.

The Service will bear 100 percent of the first $25,000 of relocation payment costs for any person, business, or farm operation displaced prior to July 1, 1972. Any such costs for a single dislocation in excess of $25,000 and all costs for relocation payments for persons displaced after July 1, 1972, will be shared by the Sponsoring Local Organization and the Service as follows:

	Sponsoring Local Organization (percent)	Service (percent)	Estimated Relocation Payment Costs (dollars)
Relocation Payments	40.4	59.6	32,340

3. The Sponsoring Local Organizations will acquire, or provide assurance that the landowners or water users have acquired, such water rights pursurant to the State law as may be needed in the installation and operation of works of improvement.

4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organizations and by the Service are as follows:

Works of Improvement	Sponsoring Local Org. (percent)	Service (percent)	Estimated Cost (dollars)
Teal Creek Reservoir	45.61	54.39	4,674,960
Diversion System	7.18	92.82	1,365,560
Irrigation Water Distribution System	50.00	50.00	1,214,280
Recreation Facilities			
Maintenance Facility	100.00	0	10,000
All Other Recreation Fac.	50.00	50.00	583,340
Fish Incubators	100.00	0	4,000
Stream Treatment	50.00	50.00	2,000

5. The percentages of the engineering costs to be borne by the Local Sponsoring Organizations and the Service are as follows:

Works of Improvement	Sponsoring Local Org. (percent)	Service (percent)	Estimated Cost (dollars)
Teal Creek Reservoir	10.34	89.66	245,500
Diversion System	3.27	96.73	102,590
Irrigation Water Distribution System	0	100.00	121,430
Recreation Facilities	50.00	50.00	59,330
Fish Incubators	100.00	0	400
Stream Treatment	0	100.00	500

Engineering services costs do not include engineering type services related to the acquisition of land and relocation or modification of improvements which are included in item 1.

6. The Sponsoring Local Organization and the Service will each bear the cost of project administration which it incurs, estimated to be $186,300 and $1,643,800 respectively.

7. The Sponsoring Local Organizations will obtain agreements from owners of not less than 50 percent of the land above each reservoir that they will carry out conservation plans on their land.

8. The Sponsoring Local Organizations will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

9. The Sponsoring Local Organizations will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

10. The Sponsoring Local Organizations will be responsible for the operation and maintenance of all structural works of improvement by actually performing the work or arranging for such work in accordance with the agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

    A separate agreement will be entered into between the Service and the Sponsoring Local Organization before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.

14. No member or delegate of Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. Sec. 15.1-15.12), which provide that no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.

POLK SOIL AND WATER CONSERVATION DISTRICT

By_____

Title_____

Date_____

The signing of this agreement was authorized by a resolution of the Board of Supervisors of the Polk Soil and Water Conservation District, adopted at a meeting held on

_____.

_____

Secretary, Polk Soil and Water Conservation District

LITTLE LUCKIAMUTE WATER CONTROL DISTRICT

By_____

Title_____

Date_____

The signing of this agreement was authorized by a resolution of the Board of Directors of the Little Luckiamute Water Control District, adopted at a meeting held on

_____.

_____
Secretary, Little Luckiamute Water Control District.

POLK COUNTY

By_____

Title_____

Date_____

The signing of this agreement was authorized by a resolution of the Board of Commissioners of Polk County, adopted at a meeting held on

_____.

_____
Secretary, Polk County

CITY OF MONMOUTH

By_____

Title_____

Date_____

The signing of this agreement was authorized by a resolution of the City Council of Monmouth, adopted at a meeting held on

_____.

_____
Secretary, City of Monmouth

SOIL CONSERVATION SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE

By_____

Title_____

Date_____

Watershed Work Plan
Little Luckiamute River Watershed

Polk County, Oregon

October 1971

SUMMARY OF PLAN

LOCATION

The Little Luckiamute River Watershed is located in Polk County on the west side of the Central Willamette Valley. The City of Falls City is the only municipality located within the watershed.

The watershed includes 52,640 acres in Polk County (82.3 square miles). The watershed is about 18 miles long and 7 miles wide at its extremes. The Little Luckiamute River originates near Fanno Peak in the Coast Range Mountains and generally flows in a southeasterly direction until it joins with the Luckiamute River.

SPONSORSHIP

This plan was prepared by the Polk Soil and Water Conservation District, the Little Luckiamute Water Control District, Polk County, and the City of Monmouth, as sponsoring organizations. Technical assistance was provided by the Soil Conservation Service and Forest Service of the U. S. Department of Agriculture and the State Engineer of Oregon. Other agencies and groups who assisted in the preparation of, or furnished materials for, the watershed work plan include:

Federal	State of Oregon	Local
Farmers Home Administration	State Engineer	City of Falls City
Agricultural Stabilization & Conservation Service	Extension Service	Pacific Power & Light
Geological Survey	Game Commission	Consumer Power
Federal Water Quality Administration	Fish Commission	Willamette Basin Project Committee
Bureau of Sport Fisheries & Wildlife	Forestry Department	Mid-Willamette Council of Governments
Bureau of Land Management	State Water Resources Board	Regional Park & Recreation Agency of Mid-Willamette Valley
Corps of Engineers	Highway Department	
National Marine Fisheries Service	Department of Environmental Quality	

WATERSHED PROBLEMS

The principal resource development problems in this watershed are flooding of cropland, inadequate water supply for irrigation during the middle to latter part of the crop growing season, an increasing demand for water-based recreation facilities which are now nonexistent, and low summer streamflows for fish. There is also a need for a municipal water supply for the adjacent rural area and the City of Monmouth.

PROJECT OBJECTIVES

The objectives of this project are to provide effective land treatment on lands in the watershed, flood protection for agricultural lands along the Little Luckiamute River, adequate full season irrigation water supplies to those lands that lack or have low priority water rights, water-based recreation facilities, improved fishery habitat, municipal and industrial water supply development for the City of Monmouth and the adjacent rural areas, and the preservation, protection and enhancement of the quality of the environment.

LAND TREATMENT

Cost of these land treatment measures is estimated to be $907,288. The P. L. 566 share, $76,606, will consist entirely of accelerated technical assistance to landowners and operators. The share borne by other funds is $830,682, of which $6,052 is borne by the Soil Conservation Service for technical assistance, $2,700 by the Forest Service for technical assistance, and $821,930 by the landowners or operators with assistance as available from the Agricultural Conservation Program or other sources.

STRUCTURAL MEASURES

A multiple-purpose reservoir for flood prevention, irrigation, recreation, fish enhancement, and municipal and industrial water is the principal structural feature of this plan. The Teal Creek Reservoir will have a total storage capacity of 25,000 acre feet, a maximum surface area of 440 acres, and the dam will be 110 feet high.

Other structural measures include a diversion system consisting of a diversion dam and 7,354 feet of diversion canal with a capacity of 1,200 cfs; an irrigation water distribution system consisting of 124,520 feet of pipeline, 18 pumps, and 104 meters; and recreation facilities adjacent to the Teal Creek Reservoir. The diversion system will be used during April and May to help fill the joint use reservoir storage area for irrigation and municipal and industrial water supply, and during the months of October through March to divert flood flows from the Little Luckiamute into the Teal Creek Reservoir during periods of high flows.

The estimated total installation cost for all structural measures is $11,141,710.

BENEFITS AND COSTS

The estimated average annual benefits of structural measures will be $1,201,810. Included are benefits for flood prevention, $121,935; irrigation, $159,055; recreation, $630,000; fish enhancement, $40,140; municipal and industrial water supply, $61,200; and secondary, $189,480.

The estimated average annual cost of these measures, including operation, maintenance, and replacement, is $729,610. The ratio of benefits to costs is 1.6 to 1.0.

COST SHARING-STRUCTURAL MEASURES

Costs for structural works of improvement are allocated to the purposes served by the structure. The allocation is: Flood prevention, $2,430,865; irrigation, $2,155,640; municipal and industrial water supply, $598,725; recreation, $3,441,270; and fish enhancement, $685,110.

The total installation costs of $11,141,710 will be shared with P.L. 566 funds bearing an estimated $7,106,380 and other funds $4,035,330.

PROJECT INSTALLATION

The installation of land treatment measures will be the responsibility of the individual landowner or operator with such financial assistance as may be available through the Agriculture Conservation Program or other funds. Technical assistance to landowners will be provided by the Soil Conservation Service and the State Forestry Department in cooperation with the Polk Soil and Water Conservation District.

Responsibility for installation of Teal Creek Reservoir, the irrigation distribution system, and the diversion system rests with the Little Luckiamute Water Control District. Recreation facilities will be installed by Polk County.

Project measures are scheduled for installation during a six year period.

OPERATION, MAINTENANCE AND REPLACEMENT

Land treatment measures on private land will be operated and maintained by the landowners or operators of the land.

Operation, maintenance, and replacement of the recreation facility will be the responsibility of Polk County. Operation, maintenance, and replacement of all other structural measures will be the responsibility of the Little Luckiamute Water Control District.

Estimated average annual operation, maintenance, and replacement cost is $127,510.

DESCRIPTION OF THE WATERSHED

GENERAL

The Little Luckiamute River Watershed, with a drainage area of 52,640 acres (82.3 square miles) is located in central Polk County, in northwestern Oregon, on the western side of the Willamette River. The City of Falls City is located within the watershed; the City of Dallas is within 2 miles of the northern boundary; the City of Monmouth is about 4 miles to the east; and Salem, the State Capitol, is about 15 miles to the east.

The watershed is about 18 miles long and 7 miles wide at its extremes. Major streams are the Little Luckiamute River and its tributaries including Berry Creek, Waymire Creek, Teal Creek, Grant Creek, Fern Creek and Cooper Hollow. The Little Luckiamute River originates near Fanno Peak in the Coast Range Mountains and generally flows in the southeasterly direction until it joins with the Luckiamute River. All the main tributaries originate in higher elevation, predominately forested areas and flow directly into the Little Luckiamute.

Watershed elevations range from approximately 3,300 feet on Fanno Peak to about 200 feet on the Little Luckiamute flood plain near the confluence with the Luckiamute River. The topography is mountainous west of Falls City and generally hilly to the east with nearly level terraces and flood plains along the river.

Located in the watershed is a falls in Falls City. As the Little Luckiamute flows into Falls City it plunges over a forty foot high cascade (between vertical rock walls) as it continues its flow downstream to the Luckiamute River. This area is in a majestic natural setting with the tall coniferous trees on the watershed slopes, the tree lined Little Luckiamute River, and the fine mist spray created by the falling water. (The picture on the cover of the plan is the falls in Falls City.)

The Little Luckiamute River, upstream from Falls City, is a beautiful river as it cascades over and around rocks in the channel surrounded by vigorous vegetation and the forested background of the steep watershed slopes. The river flows continuously the year around adding to the natural beauty of the area.

Five miles upstream from Falls City, the community of Black Rock once flourished. In 1906 the United States Post Office Department established a Black Rock post office. Black Rock was a lumbering community, and the history of the Willamette Valley Lumber Company actually began in this community. By 1912 the population was listed as 600. When logging operations began reducing, the population of the community began to dwindle until it was non-existant. Then in 1960, the Willamette Valley Lumber Company announced discontinuation of all railroad operations from Black Rock. This announcement closed the book on Black Rock and also on a method of logging in the area that persisted for 55 years.

PHYSICAL DATA

CLIMATE

The watershed has a temperate, maritime climate characterized by relatively wet winters and dry summers. Precipitation is mostly in the form of rain from general storms originating over the Pacific Ocean.

High intensity rains from thunder storms are not common in the area. The mean annual precipitation varies from 150 inches in the upper areas of the watershed to 80 inches in the vicinity of Falls City to 45 inches at the lower end of the watershed. Approximately 80 percent of the total annual precipitation occurs during the months of October through March, while the months of July and August account for only about 2 percent.

The weather station records at Dallas show an average temperature of 65.1° F. for the month of July, an average of 37.5° F. for the month of January, and an average annual temperature of 51.4° F. There is an average growing season of about 186 days.

WATER RESOURCES

Surface Water

Most of the streams of the watershed originate in the Coast Range Mountains, which are some of the highest runoff producing areas in the Willamette River Basin.

All the streams have a regular runoff pattern with low flows in the late summer and high flows in the winter months of December, January, and February. The estimated average annual yield of the watershed is 265,000 acre feet.

Groundwater

The potential for large scale development of groundwater production, either for irrigation or municipal water, is extremely limited within the watershed. The underlying rock formations are predominately marine sediments, the bulk of which are shale and siltstone. These rocks have low permeability and yield water very slowly to wells and springs. Most of the wells that penetrate these rocks yield less than 5 gpm (gallons per minute), and few wells exceed a production of 10 gpm. In many cases where deep penetration has been attempted to increase production, highly mineralized water has been encountered.

Limited development may be obtained from the thin alluvial gravel beds along the lower reaches of the Little Luckiamute River. However, satisfactory development at this source would most probably require a manifold development of several shallow wells.

Water Quality

Analysis of water samples taken by the Oregon State Department of Environmental Quality from Teal Creek and the Little Luckiamute River above Falls City shows that the water is of a high quality and very satisfactory for irrigation, recreation, and municipal and industrial water supply purposes.

G E O L O G Y

Stratigraphy

The following geologic formations are exposed within the watershed area and are listed in order of their ages, beginning with the oldest: (1) Siletz River Volcanics, composed of basalt flows and minor amounts of tuffaceous sedimentary rocks; (2) Yamhill Formation, a series of marine clayey siltstone and sandstone which includes a basal member of impure limestone locally called the "Dallas Limestone"; (3) Spencer Formation, which is a marine shallow water deposit of tuffaceous or silty sandstone with locally included basalt flows; (4) gabbro and diorite silts and dikes that intrude the older formations within the watershed; (5) recent material including terraces gravels and flood-plain alluvial deposits of gravel, sand, and fines.

Most of the upper watershed, including the Teal Creek Damsite, is underlain by the Yamhill sediments or the intrusive gabbro and diorite rocks. The lower watershed is about equally underlain by Yamhill sediments, the Spencer sediments and the recent alluvial deposits. These formations are all overlain by moderate to well developed soil profiles discussed in the following soils section.

Structure

In general the sedimentary rock formations and included intrusions slope gently to the east beneath the watershed with some local folds or crenulations interrupting this regional dip. In the extreme upper watershed this regional trend reverses and the dip is gently to the west. The alluvial and terrace deposits are for the most part level in altitude, although the terraces have been elevated several tens of feet in some areas. Faulting is minor in nature and generally confined to the extreme upper watershed area.

Geomorphology

Watershed topography shaped by differential erosion varies from the steep youthful features of the upper elevations to areas of gently rounded late maturity in the eastern third of the watershed. Where streams cut through the sedimentary rock including or overlain by gabbro or diorite, the resistant igneous rocks are undermined causing large scale block sliding. These features are frequent along the Little Luckiamute River between Black Rock and Falls City. Construction of buildings or other structures on these hazardous areas is necessarily limited. Most of the waterfalls and cascades within the upper watershed are caused by the retreat of streams to a point where they drop over the edge of the igneous sills. This is exemplified by the falls west of Falls City. Much of the water removal problems at the lower Little Luckiamute River area are the result of extreme meandering, oxbows and other low gradient stream features.

S O I L S

The soils in this watershed developed under the influence of moderately high winter rainfall and dry summers. They are humid soils, the well drained types characteristically are light in color while the poorly drained soils are gray to black. The soils of the mountainous and foothill areas of the upper watershed are residual and colluvial types formed from basalt and marine sediments. In the lower watershed, the Luckiamute terrace soils have developed from the older valley alluvial deposits. The flood-plain soils along the present stream and river channels developed from recent alluvial deposits. The following broad soil groups are based upon similarities of physical characteristics and agronomic adaptation.

Group I - Upland Soils

Upland soil areas are moderately well drained and range in depth from 20 inches to over 4 feet. They typically have very dark grayish brown, friable silty clay loam surface soils and are medium in acidity. They are formed on gently sloping to steep uplands of 50 percent and above gradients. The waterholding capacity is moderate. Permeability is moderate in the surface soil and moderately slow in the subsoil. The fertility is low. Most of these soils support stands of commercial timber and are used for the production of forest products. Cropland use is limited primarily by slope and most of these soils are located in areas removed from present agricultural development. Typical series are Hembre, Honeygrove, and Peavine.

Group II - Foothill Soils

Soils in this group are very dark brown, well drained and range in depth from 10 to 32 inches on gently to steeply sloping foothills. They are of medium acidity, slopes range from 2 to 45 percent. The permeability of both the surface and subsoil is moderate, waterholding capacity is low. These soils are used primarily for woodland production, but the less steep areas are adapted to forages, seed crops, orchards and caneberries. Some phases are suited to irrigation. Typical series are Jory, Steiwer, and Willakenzie.

Group III - Bottomland and Terrace Soils

Soils in this group are on nearly level lands, very deep, poorly to well drained, and slight to medium acidity. The permeability of the surface and subsoil is moderate to slow. These soils are fertile and can produce high yields of most crops adapted to this area. The predominant soils are Chehalis, McBee, Waldo, and Wapato.

COVER CONDITIONS

Approximately 82 percent of the watershed is forested. Conifers are predominant in the western half, while oak and other hardwoods are common east of Falls City. Most of the upper watershed was initially logged during the period 1905-1910. Reforestation has been excellent and nearly all areas are presently fully stocked.

There are two major industrial forest land owners in the watershed. These are Willamette Industries with 14,000 acres and the Boise Cascade Corporation with 3,650 acres. Both have undertaken an extensive thinning program in these second-growth stands. Present road construction and thinning operations began about 1966. Additional areas were

opened up in 1969. Road construction by these corporate ownerships is now in full swing and main roads systems will be completed in another two years. Watershed protection measures including ditching, culverts, grading, and cut and fill stabilization are necessary to minimize erosion. Special falling and yarding instructions are also employed during the harvest operations.

The thinnings are designed to improve the young growth stands from a silvicultural standpoint. Approximately a third of the basal area is removed with each thinning operation. This removes about half the existing stems, leaving a well-spaced stand of young growth. This should increase water yield without materially affecting watershed protection or disturbing the present excellent hydrologic condition.

A transitional area exists between the coniferous forests and the cropland. This area is primarily hardwood forest and accounts for about 4 percent of the watershed area. These woodlands have been periodically cut and are used for grazing and woodlot purposes. Regrowth has occurred, and good cover exists.

Eleven percent of the watershed is in cropland, located primarily in the main valley along the river. Pasture and grain are the primary crops in the upper part of this valley and along the tributaries. The main valley also grows pasture and grain but in addition produces many acres of row crops and specialty seed and oil crops. Cover crops are used on the row crop areas to prevent erosion during the winter. Cover conditions on most of the watershed's cropland is very good.

The remaining 3 percent of the watershed is in other uses, including farmsteads, roads, and the town of Falls City.

ECONOMIC DATA

ECONOMY OF THE WATERSHED

The present economy of the Little Luckiamute Watershed is based on lumbering and agriculture. Recreational activities, including fishing, hunting, summer camps, picnicking, and overnight camping, have a small but rapidly increasing impact on the general area.

There are no major industrial or commercial enterprises in the watershed. The cleared land is used strictly for agriculture. Falls City, with a population of about 800, is the only urban area in the watershed. It has a high proportion of retired people and people living on limited incomes.

Approximately 93 percent of the watershed land base is privately owned and 7 percent is county, state and Federal land. Nearly all of the public land is in the forest areas or public service areas.

Approximately 58 percent of the 43,160 acres of forest land is owned by medium or small owners (5,000 acres or less--mostly under 1,000), and 36 percent is owned by large timber companies. The remaining 6 percent is federally owned and managed, primarily by the Bureau of Land Management.

Coniferous forest covers all of the upper watershed. Approximately 43,160 acres, or 82% of the watershed area, are devoted to forest uses, including timber production, fish and wildlife habitat, and recreation; and a portion of the area is serving as an Experimental Forest and outdoor laboratory for Oregon State University.

Teal Creek drainage basin is typical of the mountainous, forested upland areas. SCS PHOTO 7-2415-5

Logging operations have been conducted over a long period of time, and the harvest of old growth and second growth timber is expected to continue on a sustained yield basis. The City of Dallas has a core mill, large planing mill, and several small saw mills.

Most of the agricultural land is located in the valley bottom along the Little Luckiamute River. There are approximately 60 operating farms or ranches in the watershed. About 25 percent are part-time operations. The bulk of the land is in 20 or 30 larger full-time farm operations, using both owned and leased land. In addition to the above farms, there are numerous small rural residential acreages.

The farmland use for the 6500+ acres of cropland is shown below. Most of the farmsteads are located on the scarp break where the steep forest lands transition to the flatter cultivated fields. There is a highway paralleling the valley bottom edge on both sides of the river, and most properties run from the road to the river or tributary. The lower half of most of these farms flood, and the entire valley bottom area is within the irrigation evaluation unit.

The major land uses of the Little Luckiamute floodplain and irrigation service areas is as follows:

Land Use	Yield per Acre
Dryland	
Native Pasture	90# beef
Improved Pasture	300# beef
Spring Barley	1.25 T
Fall Wheat	80 Bu.
Idle	--
Irrigated	
Irrigated Pasture	700# beef
Sweet Corn	7 T
Bush Beans	4 T
Strawberries	4 T
Mint	70# oil
Sugar Beet Seed	3000# seed
Red Clover	450# seed
Pole Beans	9 T

Forage harvest on presently irrigated lands. SCS PHOTO 7-2939-11

Pasture and grain are the primary crops in the upper reaches of the valley and in the adjacent stringer valleys. Farms in this upper area average about 100 acres in size and have an average yearly gross income of $3,000-$5,000. Many acres of row crops and specialty crops are raised on the large commercial farms in the lower valley. These farms average about 500 acres and have annual gross incomes of $65,000 or more.

Significant amounts of the national production of some specialty and row crops are grown in the Willamette Valley. Little Luckiamute's production of these crops is expected to increase with the provision of additional irrigation water.

Sale of farm products from this watershed averages about $800,000 yearly. The nearby Salem area is the market for much of Little Luckiamute's farm products and is also the nation's largest food processing area. Red clover and sugar beet seed are cleaned and prepared for distribution in nearby processing establishments.

Fern Valley, on the northern end of the watershed, has part-time farms operated by people who work in industries in nearby communities. This area is becomming increasingly important as the location of rural residences adjacent to the expanding City of Dallas.

Agricultural land values are related to the productivity of the soil, availability of irrigation water, flood hazard, and ease of cultivation. Values range from $200 per acre for the steeper hill lands suitable for hay, grain or pasture to in excess of $500 an acre for intensively cropped irrigated land in the valley bottoms.

Woodland land values vary considerably depending on location, accessibility, woodland site class, size of tract, and age and value of timber. Heavily cutover land or oak brush stands sell for $75 to $100 per acre if purchased for forestry or woodlot uses. Some of the lower areas are selling "rurban" home sites with acreage for $250 to $400 per acre. The value of commercial timber land varies depending on the stand. Estimated land prices are $50 to $150 per acre plus the value of standing timber.

Residential growth is affecting land values around Falls City and particularly in Fern Valley, which lies adjacent to the expanding City of Dallas. In these areas the demand for home sites with acreage is pushing land values for marginal cropland up to $300-$400 per acre.

Transportation facilities in the Little Luckiamute Watershed are reasonably good. State highway, Route 223, runs southwesterly from Dallas into the Little Luckiamute Valley. An adequate network of all-weather roads services the valley from this highway. The upper watershed is accessible by roads used mostly by logging trucks. Route U. S. 99W, a main north-south highway, goes through Rickreall, a town

about 4 miles east of Dallas. Access to the watershed is also available from Route 99W in Monmouth on the east via a state highway. Some additional logging roads will be required to complete old growth harvest in the upper watershed.

Both Dallas on the north and Monmouth to the east of the watershed are served by intercity bus lines.

LAND TREATMENT DATA

The upper area of this watershed is primarily forested. There are presently no critical erosion areas above the project reservoir or benefit areas. The flood plain along Little Luckiamute River above Kings Valley Highway, or State Highway 223, is primarily in pasture and the flood plain below the highway is in cannery crops, grain, pasture, and hay. Land use changes or improvements will continue to be extremely hazardous until flooding is reduced. With flood protection, the flood plain will be more intensively developed for agricultural production.

The watershed is in the Polk SWCD. It has a very active conservation program and will provide the necessary leadership to accomplish the land treatment and related phases of this project.

There are approximately 60 agricultural landownerships in the watershed, of which 15 are SWCD cooperators. Conservation plans have been developed on six ownerships covering approximately 1 percent of the watershed. About 20 percent of the planned conservation practices have been applied.

Forest management plans have been developed for the two corporate forest ownerships. Both are registered tree farms and comprise over 30 percent of the watershed area. In addition, five other woodland owners have received technical assistance from the State Forester's Office.

Fire protection of forest land in the watershed is provided primarily by the West Oregon District of the Oregon State Department of Forestry. Buildings and other improvements, generally in the lower portion of the watershed, are protected from fire by the Southwestern Rural Fire District. The record of forest land area burned in this watershed shows that very few fires have occurred in the past, none of which has spread to any significant acreage.

RECREATION RESOURCES

The resources which can be developed for recreation in the watershed are numerous and adaptable to the varied recreation interests that exist. An excellent recreation site is available which would provide a variety of topographic and natural beauty environment. Access from the Salem, Albany-Corvallis, and Portland metropolitan areas is good.

The recreation community within 50 miles of the watershed is in excess of 300,000 people. There are presently no reservoir-based recreation facilities available in close proximity to this watershed.

FISH AND WILDLIFE RESOURCES

The watershed is inhabited by a variety of wildlife species. Black-tailed deer are found throughout the drainage and provide fair hunting. Some black bear are also present. Upland game include ring-necked pheasants, California and mountain quail, a fair population of migratory band-tailed pigeons, and some blue and ruffed grouse. Waterfowl includes some mallard and wood ducks that are year-round residents. Additional mallards and several other species of ducks, along with Canada geese, migrate into the area during late fall and winter in the Willamette Valley. A fair population of silver gray squirrels is found in the lower areas. Furbearing animals include beaver, mink, otter, muskrat, nutria, oppossum, raccoon, red and grey fox, coyote, and skunk. Some of these animals are trapped for fur. Extensive and diverse populations of non-game birds inhabit the area, many in residence and others coming here each winter.

Historically the Little Luckiamute stream system has been inhabited by cutthroat trout which migrate between this system and the Willamette River. West side Willamette Valley streams did not support runs of coho salmon and steelhead because these fish returned from the ocean in the fall and winter months when passage over the Willamette Falls at Oregon City was difficult or impossible. This passage problem has been remedied in recent years, and the state and Federal fishery agencies have been introducing coho salmon into basin streams, including the Little Luckiamute system. Some of these introductions appear to be successful in the Little Luckiamute system. The fishery agencies believe the potential for anadromous fish runs in this system is good.

Rainbow trout have been stocked in the Little Luckiamute system. There are serval farm ponds in the area which also contain rainbow trout and warm water fish.

WATERSHED PROBLEMS

FLOODWATER DAMAGE

Flooding is the most significant problem in the watershed. The present Little Luckiamute River channel lacks sufficient capacity to contain or remove the excess runoff from the storms experienced annually in the watershed. Flooding is directly related to the seasonal precipitation pattern and frequently occurs two or more times during the period November through March. Seventy-five percent of the past floods have occurred in December, January, and February with the remaining 25 percent in November, March, and April. Even though high streamflows will ordinarily subside within 2 to 3 days, floodwaters will remain standing in some areas for several days.

An estimated 2,940 acres would be flooded on the average of once in 100 years. There are, on the average, about 1,700 acres that receive damages from floodwater each year. When the Little Luckiamute is flooding, the Luckiamute River is also usually at flood stages. It has a much longer flood duration and creates a backwater problem in the lower portion of the Little Luckiamute area because floodwaters are slow to recede.

Annual flooding damages crops and property plus creating a health and safety hazard to rural residents. SCS PHOTO 7-2852-7

The major floodwater damages to agricultural land are the reduction in crop yields, limiting of crops to flood tolerant types, and the loss of fertilizers and spray materials by prolonged inundation. Other agricultural losses are caused by debris deposition, spreading of weeds in certified seed crops, sheet erosion, leaching of soil nutrients, and occasional loss of livestock. The restrictions on normal farm operations have resulted in increased operating costs to some farmers since they must work around wet areas. There has been a major shift to row crop production below Kings Valley Highway in the last few years, even with the hazards of flooding; and this can only continue if relief from flooding is provided.

Significant damages occur to roads and bridges annually causing increased maintenance, repair and the extra cost of patrols during floods. Residents and travelers are frequently forced to detour several miles to avoid areas where the roads are flooded.

Flooding results in road damages and requires rerouting of traffic every winter. SCS PHOTO 7-2852-2

The December 1964 flood was one of the largest floods of record. The peak discharge was estimated as having a 5 percent chance of occurrence. Nearly 2,900 acres were flooded and floodwater remained on parts of the area for several days causing extensive damage. Serious damages occurred to properties as a result of the out-of-bank flows and considerable damages resulted to roads and bridges. Flooding was also widespread throughout the Willamette Basin and other parts of the Pacific Northwest. During this flood, Kings Valley Highway was overtopped and acted as a dam. It created a flood pool over a mile wide above the highway. The Luckiamute River was also at flood stages and remained there over 5 days. This delayed the evacuation of floodwaters from the lower Little Luckiamute. The floodwater damage for this flood event were estimated to be about $128,720.

During the past 2 years the landowners have made a concentrated effort to remove the massive log jams that accumulated as a result of the December 1964 flood and floods since then. Most of these log jams have been removed, but a constant vigil is needed to keep additional logs and debris from collecting.

The total average annual damages are estimated to be $79,830, of which $42,780 are crop damages; $16,690 are other agricultural; $12,010 are road and bridge damages; and $8,350 are indirect damages.

Erosion

Erosion rates within the watershed vary from very low in the well forested upper watershed and flat alluvial flood-plain areas, to moderate in the cultivated areas of footslope; and high in areas of recent logging operations in the upper watershed. Local areas of stream bank erosion, generally related to debris jams or cultural disturbance, occur along the lower Little Luckiamute channel. Significant sediment contribution occurs from periodic landslide action along the steeper valleys of the Little Luckiamute River above Falls City. The following average annual sediment yield values have been assigned as representative of the areas indicated: well forested areas, 0.1 acre foot per square mile (AF/sq.mi.); rolling footslope areas under cultivation, 0.3 AF/sq. mi.; alluvial flood-plain area, 0.1 AF/sq. mi.; and isolated and periodic landslide areas or denuded and unprotected logged over areas (including raw skid trails) 1.0 AF/sq.mi.

Sediment Deposition

Channel deposition is generally the result of debris or vegetative obstructions. Road ditches and slope breaks also receive some deposition. On cropland areas, deposition is mostly local, on-farm sheet type deposits in shallow depressions or along the footslope below cultivated or fallowed areas. A large percentage of the streams sediment load passes through the watershed in suspension, thus adding to the downstream water quality problems.

PROBLEMS RELATING TO WATER MANAGEMENT

DRAINAGE

Several soils on the terraces and flood plains require drainage. On these wet soils farm operation efficiency is restricted. Delayed planting causes high production costs and reduced yields. The drainage problem is aggravated by the frequent flooding. Without an adequate level of flood protection the existing outlets do not function fully and the needed on-farm land treatment measures such as drainage mains and laterals, tile drains, and land smoothing cannot be installed effectively.

IRRIGATION

Little Luckiamute is typical of the lower elevation streams of northwestern Oregon. Winter runoff volumes are large, but flows decrease rapidly during the spring. Summer flows are over appropriated by existing water rights. There is only sufficient natural streamflow to adequately irrigate about 1080 acres with a full season supply of water. The present summer supply of water is critically short, and the situation is anticipated to become even more critical with the shifting of land use from non-irrigated to irrigated crops. Adjudication of water rights is needed to help relieve some of this problem.

The Little Luckiamute River Watershed climate and soils are ideally suited to the production of specialty crops, such as bush beans, when adequate water is available for irrigation. SCS PHOTO 7-2939-6

Presently all of the irrigation is by pumpage from natural streamflow and the application by sprinklers. Low flows during the summer months have caused problems with the functioning of the pumps and have resulted in high maintenance costs. This has also resulted in reduced efficiencies, thus requiring more water.

As discussed in the soils section, the soils are fertile and are suited to a wide variety of crops. Any major irrigation expansion in the watershed is dependent on the development of an adequate source of water.

MUNICIPAL AND INDUSTRIAL WATER

Falls City and Monmouth obtain their water from Teal Creek and from springs. These sources appear to be adequate to satisfy the future needs for Falls City.

Monmouth, however, has been experiencing shortages during the summer months for at least the last ten years and has had to ration water to its citizens. Monmouth is one of the fastest growing rural communities in the Willamette Valley, and city officials expect this growth to continue. Monmouth is the home of the Oregon College of Education, and it has also been growing at a very rapid rate.

In 1969 Monmouth drilled several wells near the Willamette River and obtained a maximum flow of 400 gpm to supplement existing supplies. The wells have provided relief to Monmouth during the summer months, but do not fully meet the present needs.

Domestic water is a serious problem in the watershed and also in other portions of Polk County as groundwater sources are not available. To solve some of these problems the Luckiamute Domestic Water Association was formed and a plan developed to supply domestic water to farmsteads in portions of the Luckiamute and Little Luckiamute valleys. This spring, 1970, the plans became a reality, and domestic water is now available to many users in the watershed area.

There are still many farmsteads in the watershed and the southern half of Polk County without an adequate quantity and quality of water. A dependable supply of water is needed to solve these problems.

FISH AND WILDLIFE

Wildlife related problems include changes in wildlife habitat through certain agricultural and logging operations. Rapid changes occur in vegetation on logged off areas where wildlife food is at first plentiful and then declines as rank growing vegetation creates a closed canopy and poor quality feed for deer. Streamside trees and shrubs are valuable wildlife habitat, and extensive clearing destroys

important den or nest trees for animals such as the racoon and birds such as the wood duck. Some wild animal populations cause occasional damage to property. Examples are rodents burrowing in ditches and dikes, crop damage by deer, and fruit tree cutting by beaver. Nutria are also causing considerable damage to streamside crops.

Low summer streamflows and heavy diversions have caused warm water temperatures, reduced rearing areas and increased competition from rough fish populations and predator birds all of which provide poor habitat for either resident or anadromous game fish.

Historically the fish passage problem over Willamette Falls at Oregon City during low flow periods drastically limited fall run fish. This difficulty has been largely corrected by the installation of a modern fishway, which is nearing completion. Fall fish runs are expected to make increased use of the Little Luckiamute. Anadromous fish passage is blocked in the Little Luckiamute River at Falls City by a high natural falls. However, surplus coho salmon have been stocked above the falls to spawn in the stream above.

R E C R E A T I O N

Public recreation development in the Little Luckiamute basin is limited by access and the absence of outstanding recreation features. There are no large impoundments or public waters in the watershed or within an hours drive of the watershed. The closest impoundment facilities are Fern Ridge near Eugene, a distance of about 70 miles, Detroit Reservoir on the North Santiam River east of Salem, a distance of about 70 miles, and the Green Peter and Foster Reservoirs on the South Santiam River southeast of Salem, a distance of also about 70 miles.

Most of the streamside access is in private ownership and often distant from public roads. There is only one streamside park in the watershed, Gerlinger Park above Falls City on the Little Luckiamute River. There are few private recreation developments in the county and most of these are restrictive to special groups. These developments include two organizational camps and several private waterfowl hunting areas. The organizational camps are Camp Kilowan on Teal Creek and the Baptist Church Camp near Black Rock above Falls City.

The watershed is within easy driving distance of the cities of Salem, Albany, Eugene, and Portland and could provide recreation to these intensive population centers.

There has been a considerable amount of interest in developing recreation facilities in the watershed. This interest has been expressed publicly by the residents of Falls City, the City of Monmouth, the Little Luckiamute Water Control District Board, and the Polk County Commissioners.

PROJECTS OF OTHER AGENCIES

There are no water resource development projects planned or being planned by other agencies within the Little Luckiamute River Watershed. However, the Willamette Basin Comprehensive Study identifies a reservoir site on the Luckiamute River near Pedee which is recommended for early action by the Corps of Engineers. This reservoir would provide flood protection on the Luckiamute River which would effect the outlet conditions for the Little Luckiamute. The Corps of Engineers project would be complementary to this plan and there would be no conflict between the two plans.

PROJECT FORMULATION

PROJECT OBJECTIVES

The project formulated for the Little Luckiamute River Watershed will as nearly as possible meet the objectives desired by the local sponsors which can be included within the framework of Public Law 566. The land treatment and structural measures selected for inclusion in this work plan are those that meet the project objectives at the lowest annual cost.

The objectives to be met by this project have been agreed to by both the sponsors and the Service as being adequate to provide the level of protection or development desired for each project purpose.

Project measures are planned to provide conditions for more intensive and diversified land use and to assist in the development and stabilization of the economy of the area. The land treatment and project measures are also planned for the protection, preservation, and enhancement of the environment of the area.

Consideration was given to all other water resource plans existing or being planned for this watershed and the adjacent areas to assure that elements of this plan will be compatible with full development of the entire region.

The objectives of the project are to provide, through a multiple-purpose project development, a combination of land stabilization, flood prevention, recreation, fish and wildlife, municipal and industrial water supply, and irrigation benefits.

The fire protection objectives are to minimize the potential that exists as much as possible. Steps to be taken are preseason fire prevention planning, the use and availability of modern equipment and the placement of high use recreation areas away from hazardous locations.

The flood prevention measures are to achieve the objectives of providing the maximum justifiable level of flood protection along the Little Luckiamute River floodplain not affected by backwater from the Luckiamute River. The peak flows are to be significantly reduced, the duration of flooding is to be reduced on 2,740 acres, and the average annual floodplain inundated is to be reduced 1,140 acres or by 67 percent. In addition, the Little Luckiamute is to be maintained free

of log jams, thus providing conditions for quick and orderly removal of excess runoff. Also, the fairly erodible channel banks are not to be disturbed, and the natural beauty and aesthetic value of the stream channel will be preserved. The fish and wildlife habitat of the Little Luckiamute River is also to be conserved.

The recreation objectives are to provide high quality, water-based recreational areas, including installation of high intensity recreational developments to help meet a rapidly increasing recreational demand. Recreational measures will be included to assist in meeting regional needs to the extent that facilities can be installed and operated compatibly with the other project purposes.

Objectives for development for municipal and industrial water supplies are to provide high quality supplemental water to help meet the immediate water supply needs for the City of Monmouth and the long term water needs of the watershed and adjacent areas in Polk County. Monmouth's objective is for storage of 1,000 acre feet, and Polk County's objective is for storage of 2,875 acre feet.

Project irrigation objectives are to provide an adequate full season water supply, with a minimum reliability of meeting full season requirements 8 out of 10 years, for approximately 4,100 acres of cropland nearly all of which is now producing dryland crops.

Project fish and wildlife objectives are to enhance the fish resources of the watershed and salmon and steelhead fishery of the Willamette and Columbia Rivers to the extent facilities included can be installed and operated compatibly with the other project purposes.

FORMULATION PROCEDURES

Determination of Needs

Inventories were made by sponsoring local organizations with assistance of the Service to determine the needs for each of the project purposes.

Flood damage surveys were conducted with individual landowners to determine the extent of present damages. Land use projections by county and regional planning commissions and by the sponsors were used to determine the level of future agricultural production and the degree of flood protection that would be necessary for these projections.

Recreational needs were determined by the Regional Park and Recreation Agency of the Mid-Willamette Valley. Material on recreational needs for this area was taken from planning commission and other agency reports covering recent surveys in this area. Meetings were held with representatives of local, State, and Federal recreation agencies to

determine the nature and scope of recreation needs which could be met by this project. Inventories were also made of existing nearby recreation facilities to obtain a projection of expected recreational use.

The City of Monmouth and Polk County have inventoried their present and future needs for water supplies and by letter indicated their interest in obtaining project water. The City of Monmouth and Polk County have strongly supported their interest in municipal and industrial water supply at public meetings and in releases to the press.

The watershed area and much of Polk County is lacking in groundwater for development for water supply purposes. This is characteristic and typical of most areas in the Coast Range. Polk County recognizes the need for developing sources of water supply for future development. They are very much interested in providing guidance in the future growth of the county.

The inventory of irrigation needs was accomplished by an interest sign-up of landowners. The acreage planned for project water delivery was signed up for project irrigation water supplies with a financial contribution to the Water Control District in proportion to the acreage signed. The acreage to be served includes most of the irrigable land in the watershed that does not have a high priority water right or on which a water right is lacking. The irrigation sign-up included the crops to be grown and the location of land to be irrigated. This acreage was carefully reviewed by the Water Control District Board, and additional areas were included which they felt strongly would be needing irrigation water from the project. The necessary reliability was determined by establishing the requirements to support the crops to be grown with reasonable adjustment to crop acreages in dry years.

Fish and wildlife mitigation and enhancement needs were determined through consultation with the Oregon Game Commission, Fish Commission of Oregon, National Marine Fisheries Service, and the Bureau of Sports Fisheries and Wildlife.

Federal land administered by the Bureau of Land Management has good cover conditions and is well stocked with 20 to 30 year old coniferous reproduction. The Bureau of Land Management has reviewed their management plan for those areas in the Teal Creek drainage basin and 260 acres will be harvested beginning in 1972. For those lands in the Little Luckiamute drainage area above Falls City, thinning operations are planned to begin in 10 to 20 years.

Irrigated pasture is projected to be a major land use. SCS PHOTO 7-2864-4

Selection of Measures

Land treatment measures were given the first consideration in obtaining the project objectives. Wherever the problems cannot be solved feasibly by land treatment, structural measures were considered to accomplish the desired goal. Land treatment practices to be included were determined from technical guides developed for treatment of each soil group and land use.

Although the incidence of fires has been very low in the past, the potential exists. Fuel concentration, high fire danger, and a large influx of people could combine into a serious fire; but with the advent of modern fire suppression techniques and equipment, proper location of roads and fire breaks, and placement of high use recreation areas away from hazardous locations should greatly lessen any potential danger. Preseason fire prevention planning, coupled with extra ground and aerial patrol on days when fire index ratings and wind conditions indicate a potential hazard, should further lessen the danger.

Structural measures in this plan were selected on the basis of the most effective and economic combination to accomplish the project objectives. Several alternative combinations of measures, evaluation units, and levels of protection were investigated during planning.

The final determination on the combination of measures to be included in the plan was made by the sponsors with the agreement of the Service. Capacity for flood prevention in single purpose and multiple purpose reservoirs was considered as the first structural measure alternative to meet the flood prevention objectives. Wherever the flood prevention capacity became too costly other structural measures were considered.

One of the sponsors' objectives is to maintain the Little Luckiamute free from log jams and debris deposition and to not disturb the channel banks, if at all possible. Several of the landowners along the Little Luckiamute have experienced the losses of farmland due to the erodibility of soils on the channel banks during high flows.

Due to the large volumes of excess runoff experienced annually, the erodibility of the soils on the channel banks, and the high velocities that are experienced, any channel improvements were determined to be not feasible both physically and economically.

Investigations of alternate sites were made to establish the most feasible location of reservoirs. Consideration was given to locating a damsite below Grant Creek on Teal Creek. This site was eliminated as the sponsors wanted to preserve the Grant Creek area for future development. Also the Grant Creek drainage area is small and would have a relatively minor effect in reducing flood flows. Consideration was also given to locating a reservoir site further upstream on Teal Creek. This location had a much less desirable storage basin and the level of project development desired could not be attained. The site selected was found to be the most physically feasible and least costly to provide the capacity needed.

A floodwater detention structure was considered on the Little Luckiamute River above Falls City. This site has major structural problems due to the potential slides above the reservoir area along with excessive costs. Consideration was then given to a diversion system to divert flood flows from the Little Luckiamute River, about 1000 feet upstream from Falls City, into the Teal Creek Reservoir. This alternative was found to be the most feasible in meeting the flood prevention objectives.

The reliability and predictability of the annual runoff, the occurrence of the flood season (October through March) and storage requirements for the various purposes permitted the consideration of the joint use of the flood storage area in the Teal Creek Reservoir. The operation of the diversion system and Teal Creek Reservoir for filling during the spring months (March, April, and May) in no way detracts from the flood prevention feature of the project, but actually enhances the overall project.

A water sample was taken from Teal Creek at the location where the City of Monmouth and Falls City get their municipal water, by the Oregon State Department of Environmental Quality. (The results of this sample are shown in the Investigations and Analyses Section.) The test shows Teal Creek water to be of high quality for recreation, irrigation, fish and wildlife, and municipal and industrial water supply.

In determining the level of development for recreation, consideration was given to minimizing reservoir drawdown, the need for inundating soils having less desirable characteristics for recreational development, enhancement of access to the development, and maintenance of the esthetics and environmental values of the site. To evaluate these, the Regional Park and Recreation Agency of the Mid-Willamette Valley prepared a recreational plan for the Teal Creek Reservoir. A number of meetings between the Recreation Agency, the sponsors, the Soil Conservation Service, and the Extension Service was held to discuss the recreation proposal. Three different storage levels in the Teal Creek Reservoir were considered, and the impact of each on the recreation proposal was analyzed. Based on these meetings and subsequent public meetings, the sponsors and the Service agreed that full development of the Teal Creek Reservoir, within the confines of P.L. 566, was desirable and essential to meet the objectives and needs of the watershed and of Polk County.

The level of recreation development planned will provide for a design capacity of 2,640 (number of people at one time on a Sunday during normal heavy use season). At design capacity, the projected use by major activities is as follows:

Recreation Activity	Number of People
Picnicking	1680
Swimming	250
Boating and water skiing	200
Camping	120
Nature walks and hiking	200
All other activities	190
Total	2640

In determining the level of development for fishery purposes the sponsors and the Service worked closely with Oregon State Game Commission, the Fish Commission of Oregon, the National Marine Fisheries Service, and the Bureau of Sports Fisheries and Wildlife to determine if mitigative measures for anadromous fish would be needed and if there were fishery enhancement potentials. Based on a field review and the stocking program of the streams in the watershed for the next ten years, it was determined that mitigative measures would be needed. The location of the reservoir, the spawning areas that would be covered, and the proximity to the Oregon State Game Commission offices and Fish Commission hatcheries indicated that a trap and haul facility would be the most desirable. The rearing of fingerling salmon in the

Teal Creek Reservoir was also examined, and it was determined that it would be highly desirable and beneficial. These fishery agencies then provided estimates of the benefits that would accrue from this operation from sports fishing and commercial fishing. These benefits are wide spread and are not only within the watershed but also along the Willamette and Columbia Rivers as far downstream as Astoria, the outlet of the Columbia and the Pacific Ocean.

The reservoir has 3,000 acre feet of permanent storage allocated to anadromous fish enhancement, but the entire permanent pool proposed for Teal Creek Reservoir is needed to rear the young salmon.

The delivery of water for irrigation will all be accomplished through a buried, pressurized pipeline system with an appropriate regulating reservoir and necessary pumps. An alternative of releasing water from storage down the existing stream system was considered. This alternative, however, required more storage, required higher maintenance costs, was far more difficult to manage, and would have higher average annual costs. Application of irrigation water is to be with sprinkler systems in order to allow the highest efficiency possible and make the maximum use of the storage provided.

The Little Luckiamute River Watershed is one of 26 small watershed projects that are included in the early action plan of the Willamette Basin Comprehensive Study, which is nearing completion. The highlighting of this project in the basin study was instrumental in bringing it to the forefront for development of a work plan at an early date.

In the basin study future demands have been projected by purposes for the years of 1980, 2000, and 2020. The proposed plan will meet a portion of these future demands. To illustrate the relationship of the basin with the watershed project, the basin study 1980 projections for future demands by purpose are compared to the needs met by the watershed project. These comparisons are as follows:

1. The projected lands to be irrigated in the basin are 430,000 acres, and the project will serve 4,100 of these acres.

2. The projected demands in the basin for fall Chinook salmon for commercial fish are 7,208,000 pounds, and angler-days of sport fishing are 707,000. The project will provide an estimated 31,500 pounds of commercial fish and 3,750 angler-days of sport fishing.

3. The projected demands in the basin for municipal, industrial, and rural-domestic average water use are 614.8 million gallons per day (MGD) or 688,670 acre feet. The project will provide a storage of 3,875 acre feet.

4. The projected flood storage requirements to provide effective control of the 100-year flood on the Willamette River at Willamette Falls are for new storage of 1,850,000 acre feet. The project provides for the flood storage of 8,800 acre feet.

5. The projected recreation facility needs in the basin for water-related activities are 9,283,000 recreation-days. The project recreation facilities will provide an estimated 420,000 visitor days.

WORKS OF IMPROVEMENT TO BE INSTALLED

LAND TREATMENT MEASURES

Land treatment costs listed in Table 1 are for those measures needed to provide watershed protection, land improvements, and the level of agricultural water management necessary to obtain total project benefits. All project land treatment will be installed on non-Federal land.

Measures to be installed on cropland include practices to provide efficient distribution and application of irrigation water and the orderly removal of excess water. Practices including drainage mains and laterals and tile drains will be used singly or in combinations. Practices such as irrigation sprinkler systems will be combined with irrigation water management to obtain efficient on-farm water application. Other practices or combinations of practices will include conservation cropping systems with cover crops, crop residue use, and pasture and hayland plantings.

Land treatment measures to be installed on woodland include measures to provide protective vegetative cover and to improve the productive capacity of these lands. Practices such as tree plantings, and cultural practices to maintain these plantings, will be installed on land where logging, construction, fires, or excessive grazing have depleted ground cover. Accelerated fire protection will be implemented where increased use is expected. The State Forestry Department will provide the technical assistance necessary for these woodland practices.

Technical Guides prepared for the application of practices in the Soil and Water Conservation District will be used in the planning of the specific combination of practices needed on each tract of land.

Soil surveys have been completed on 5,000 acres, which include nearly all of the benefit area. An additional area of approximately 47,000 acres will be surveyed prior to installation of project measures. The surveys will be made by use of going program funds used to assist the Soil and Water Conservation District.

Most of the land treatment measures will be installed on private agricultural land. Treatment on non-agricultural land will include critical area seedings and other land stabilization and sediment reduction practices.

Details on cost distribution and status of the present application of land treatment measures are shown in Tables 1 and 1-A.

STRUCTURAL MEASURES

TEAL CREEK RESERVOIR

The Teal Creek Reservoir will be a multi-purpose structure for flood prevention, irrigation, municipal and industrial water supply, fish and wildlife, and recreation. The damsite is on Teal Creek about 1 mile upstream from the confluence with Little Luckiamute River and about 3 miles upstream from State Highway 223. This structure will control 9.83 square miles of the Teal Creek drainage and will provide storage for the diversion of flows from 30.34 square miles of the Little Luckiamute River.

The dam will be a compacted homogeneous earth fill with impervious earth core. The dam will be 110 feet high, with a top width of 28 feet, top length of 3,300 feet, and a total embankment volume of 4,040,000 cubic yards. The upstream side slopes will be 4-1/2:1, and the downstream side slopes 3-1/2:1. Consideration will be given to berms during the final design of the embankment.

The embankment foundation consists of gently downstream dipping thin bedded sandstone and siltstone of the Yamhill Formation. The permeability of this unit is very low due to the significant tuff content and fine grained nature of these sediments. No serious stability hazards are anticipated, and since these sediments have been extensively preloaded the settlement factor should be negligible.

Immediately overlying these sediments in the flood-plain section are 6 to 8 feet of pebbly sand and gravel. The settlement factor of this material is low, but the permeability is significant. A well developed soil profile of 8 to 12 feet of clay and clayey silt overlies the gravels and extends up the right abutment and the lower left abutment. These uppermost two units will be cut off by a core trench which will extend from 5 to 10 feet into the underlying sedimentary formation.

Construction materials for the embankment will be obtained from within the reservoir basin. Riprap rock is available from a sill of gabbro extending along the upper right reservoir abutment.

At the crest of the emergency spillway, the capacity will be 25,000 acre-feet with a surface area of 440 acres. At the crest of the principal spillway the reservoir capacity will be 16,200 acre-feet with a surface area of 360 acres. The 8,800 acre-feet of storage between the

principal and emergency spillway crests will be jointly used for irrigation and municipal and industrial water supply storage and flood prevention. Of the 8,800 acre-feet jointly used, 6,216 acre-feet are for irrigation and 2,584 acre-feet are for municipal and industrial water supply and includes evaporation losses.

In addition to the 8,800 acre-feet of joint use storage, the reservoir will have 16,200 acre-feet of single purpose storage for recreation, fish enhancement, municipal and industrial water supply and sediment. The recreation storage will be 11,528 acre-feet, fish storage will be 3,000 acre-feet, municipal and industrial water supply will be 1,291 acre-feet and sediment storage will be 381 acre-feet. (all figures include evaporation and seepage losses.)

Of the 11,528 acre-feet of capacity provided for recreation, 50 acre-feet are subject to withdrawal to satisfy the landscaping and vegetative needs of the recreation development.

The permanent fish enhancement and recreation pool will have a surface area of 340 acres and a storage capacity of 14,397 acre-feet which includes 381 acre-feet of sediment storage. This storage will occur after the seepage and evaporation has taken place and will be the lowest level of storage.

The emergency spillway will be a box-inlet reinforced concrete structure located in the left abutment. The box-inlet, conduit and SAF basin will be located on an undisturbed earth foundation. The capacity of the emergency spillway will be 4,300 cfs which will pass the freeboard hydrograph storm. The spillway will operate only when flows exceed the 1 percent chance flood event or after the reservoir is full for passage of downstream migrant salmon and steelhead.

The principal spillway will be incorporated into the box-inlet and will consist of two levels of orifices on the front of the box-inlet. The orifices will be gated for operation of the joint use storage capacity and for fish passage in the early spring. The flood regulation gates and spillway will be designed to facilitate the downstream migration of young anadromous fish from the reservoir. The principal spillway will operate in two stages with the low stage having a maximum outflow of 245 cfs and the high stage having a maximum outflow of 1,900 cfs.

An additional outlet in the left abutment will be used to release water for irrigation, municipal and industrial water, downstream rights, and for the fish handling facilities. This outlet will have a capacity of 190 cfs and can be used to drain the reservoir to the level of the sediment pool to meet state permit requirements. The outlet pipe will be encased in concrete, have upstream and downstream control valves.

The box inlet spillway, SAF basin, and control outlets will have fencing and handrails where necessary for protection of the facilities, the operator and the general public.

Measuring devices will be installed with the outlet structure to provide for accurate regulation of water released. Stage recorders will be installed above and below the reservoir to record inflow, reservoir storage releases, to meet requirements for the maintenance of streamflow and to pass streamflows required for prior rights through the reservoir.

Approximately 2.8 miles of county road now located in the reservoir will be abondoned. Approximately 9,600 feet of new road will be constructed to provide access to the area served by the abondoned roads. Also included will be the relocation of about 2 miles of waterline for the City of Monmouth and Falls City and about 1 mile of powerlines.

A fish trapping and holding facility, for mitigation of anadromous fish, will be built adjacent to Teal Creek immediately below the dam. This facility will be located on the south side of the outlet works and will consist of a holding pond with necessary controls, access, protective measures for handling of the fish and a utility building. The entire area will be fenced to prevent vandalism and theft.

The reservoir will be cleared of trees and brush up to the crest of the emergency spillway. The clearing of the reservoir of all brush and trees should assist in maintaining water quality in the initial filling and subsequent years.

Approximately 600 acres will be needed for the dam and reservoir, including the right-of-way strip around the reservoir to allow unimpaired public access and use. The land is now all in private ownership.

Land rights acquisition will displace approximately 14 families. Three farm operations which will be displaced are included in this number. There will be about 45 people displaced by construction of this reservoir.

See Tables 1, 2, and 3; Figures 3 and 4; and the Investigations and Analyses Section of this plan for additional details on cost distribution, design, quantities, and construction features.

D I V E R S I O N S Y S T E M

A combination diversion dam across Little Luckiamute River and 7,354 feet of concrete lined diversion canal will divert water from the Little Luckiamute River into the Teal Creek Reservoir for flood protection during the flood season and filling of the joint use flood storage area in April and May for irrigation and municipal and industrial water supply purposes.

Diversion Dam

There will be a concrete overflow diversion dam with a straight drop inlet spillway constructed across the Little Luckiamute River about 1,000 feet upstream from Falls City. The dam will have a system of gated orifices on the front of the spillway for the regulation of the amount of water that is diverted into the Teal Creek Reservoir via the diversion canal. The diversion dam will divert flows from 30.34 square miles of Little Luckiamute River.

The amount of water diverted will depend on the season of the year. During the flood season, October through March, 500 cfs will pass by the diversion dam down Little Luckiamute before any flow is diverted into the diversion canal. During these months of high runoff and flood flows a maximum of 2,000 cfs will be diverted into the diversion canal.

During the months of April and May the orificies will be regulated to divert water into the Teal Creek Reservoir for filling the flood storage area for the purposes of irrigation, municipal and industrial water supply, and for passage of downstream migrant salmon and steelhead. The maximum flow to be diverted into the diversion canal will be 150 cfs during these months. Also, the orifices will be regulated from April 1-15 to pass 25 cfs through the diversion dam and down Little Luckiamute before any flow is diverted into the diversion canal. From April 16 - May 31 the orifices will be regulated to pass 50 cfs or the natural flow through the diversion dam down Little Luckiamute before any flow is diverted into the diversion canal.

During the months of June, July, August, and September the orifices will be regulated such that no flow will be diverted from the Little Luckiamute River.

Diversion Canal

The diversion canal consists of a 7,354 foot concrete lined canal from the point of the diversion dam through the vicinity of Falls City, through the ridge between the Little Luckiamute and Teal Creek drainage areas and into the Teal Creek Reservoir.

At the point of diversion a maximum of 2,000 cfs will be diverted to a point 320 feet downstream from the diversion inlet; 800 cfs of this flow will be returned to Little Luckiamute by means of a side weir and a flume. This will insure the diversion of 1,200 cfs into Teal Creek Reservoir during flood events.

The diversion canal will cross Little Luckiamute about 600 feet downstream from the diversion dam and will be supported by concrete piers. Portions of the canal, through Falls City and the ridge between

Teal Creek and Little Luckiamute, will be constructed as a covered box culvert. This will provide a more desirable structure through Falls City. It will also eliminate having an undesirable deep cut through the ridge, reducing a potential safety hazard.

During the final design of the diversion canal, consideration will be given to a waterway that will fit into the landscape and be a pace-setting concept in the preservation of the natural setting. Consultation with qualified architects, trained ecologists, and recreation specialists will be done to provide the best possible design for the environment and create recreation opportunities in addition to the intended purposes.

Foundation material along the alignment of the diversion canal will consist of the following units: The diversion structure and initial canal section underlain by the gabbro sill forming the lip of Falls City falls; the middle section underlain by alluvial silts and gravels and weathered sediments of the Yamhill Formation; the lower section including the cut through Oakhurst Ridge underlain by weathered Yamhill sediments. No unusual excavation problems are anticipated along this alignment.

It will be necessary to fence the diversion canal to prevent deer and other animals from entering and becoming trapped in the canal. The number and location of animal crossings will be determined by the sponsors and the fish and wildlife management agencies.

For information on amounts and costs and structural data see Tables 1, 2, 2-A, and 3-B. Location and layouts are shown on Figures 3, 5, and 6, and the Project Map.

I R R I G A T I O N W A T E R

D I S T R I B U T I O N S Y S T E M

The irrigation water distribution system will supply water under pressure to 4,100 acres of cropland. The pipeline system will include 124,520 feet of pipe ranging in size from 4 to 39 inches. A metered outlet will be provided for each farm unit.

A regulating reservoir located at approximately elevation 470 (msl) along with 18 pumping plants will be included in the distribution system to provide adequate pressure at all delivery points for sprinkler operation. The larger pumps will be in-line multi-stage turbines. Smaller pumps will be in-line centrifugal.

In-line pumps will be installed in pump houses along with the necessary controls and fencing for protection of the equipment, the operator, and the general public. Fencing will also be installed around the regulating reservoir.

RECREATIONAL FACILITIES

The recreation facility on Teal Creek Reservoir consists of five units designated for planning purposes as Falls City Meadow, Teal Crest Park, Timber Hills, King Ranch, and Kilowan Parkway, with an approximate area of 258 acres. This facility is designed for an annual capacity of 420,000 visitor days with a peak day load of 6,600. The area to be developed is now private land which will be acquired by the local sponsoring organization in fee-simple title prior to the installation of the facility. The units are located to provide the desired esthetic values, accessibility, and most advantageous use of the reservoir.

The area will be designed for intensive day use facilities and overnight camping. Arrangements for use by the physically handicapped will be provided. The facility will include picnic areas, camping areas, swimming beaches with bathhouses, swimming docks, protective log booms, playground areas, boat launching, and docking areas. A combination of asphalt and sod parking areas will be provided for a peak load of 560 cars and car-boat-trailer combinations.

Sanitary facilities will include flush type toilets, with septic tanks. All septic tank effluent will be pumped to drain fields outside of the reservoir drainage. The system will be designed to meet the requirements of Public Health Agencies. Water quality will be protected further by boating regulations, including waste disposal established in cooperation with the Oregon State Marine Board.

Access to the recreation areas will be provided by existing State and county highways, augmented by a two-lane road system within the recreation facility. Traffic control, visitor assistance, and safety features will be supervised by the recreation sponsor. The design layout of the facility will allow for future expansions which can be made efficiently, while maintaining the esthetic advantages of the site.

The stream system draining into the reservoir will be treated for the removal of undesirable fish species prior to the establishment of game fish by the Oregon State Game Commission. Future treatment will be applied as periodically required to protect the fishery management program.

For information on amounts and costs see Tables 1, 2, 2-A, and 2-B. Facility locations and layout are shown on Figure 3 and on the Project Map.

EXPLANATION OF INSTALLATION COSTS

ESTIMATED COSTS

LAND TREATMENT MEASURES

Installation costs shown in Table 1 for land treatment measures include costs for establishing the measures and for associated technical assistance for planning and applying the measures. Technical assistance included for land treatment measures to be installed on cropland and grassland includes soil surveys, conservation planning, and supervision of practice application.

Included in costs of land treatment are $826,930 for application and $80,358 for technical assistance in planning and applying these measures. Technical assistance includes $8,752 from going program funds ($6,052 from the Service and $2,700 from the Forest Service), and $71,606 from P. L. 566 funds ($67,406 from the Service and $4,200 from the Forest Service) to assist in accelerating the rate of land treatment installation.

STRUCTURAL MEASURES

Construction

Construction costs include the contract or force account cost for installing structural measures including the following items:

1. Site preparation.

2. Removal of all improvements which will be abandoned.

3. Flagmen and other protective devices such as barriers or lights required to protect workmen or the public during construction.

4. The cost of excavation and installation of a closed conduit crossing a road or street when it is an integral part of an overall closed conduit system. Included are approximately 10 crossings of public and private roads by project pipelines.

5. Catwalks, handrails, fences, and other safety measures needed at Teal Creek Reservoir and at the pumping plants for the proper function, operator safety, and for the safety of the public using the recreational development at the Teal Creek Reservoir.

6. Provisions for fire prevention or suppression necessary during project construction activities.

7. Disposal of waste materials in accordance with sound engineering design and construction principles including placing, smoothing, and revegetating excess excavated materials. Included are disposal of strippings from borrow areas or from structure foundations, debris removal from right of ways, and material in excess of backfill needs for pipelines.

The estimated construction costs include a contingency allowance varying from 10 to 30 percent depending upon the possibility of unforeseen construction costs. The larger contingencies were included where subsurface conditions cannot be fully determined until more intensive investigations have been conducted for final design. The average contingency for all construction items is 20 percent.

The total estimated construction cost is $7,854,140.

Engineering Services

Engineering services include the direct costs of engineers and other technicians (includes amounts paid under contracts to private A&E firms) for surveys, investigations, design, and the preparation of plans and specifications for structural measures including the associated vegetative work; but does not include engineering services needed in connection with the alteration, relocation, or modification of utilities or services connected with land rights acquisition. Estimated total cost of engineering services is $529,750, which includes $7,550 for core drilling, grout testing, and soil tests on the Teal Creek Dam.

Project Administration

Project administration costs include administrative costs associated with the installation of structural measures. Costs included for construction contract administration are $40,270. Other project administration cost items include costs for negotiating and administering architectural or engineering services contracts, review of engineering plans prepared by others, construction layout, inspections services during construction, and administrative costs of

Government representatives. The cost for relocation assistance advisory services ($3,600) is also included as part of project administration costs. This service will be provided by Polk County. This service will provide written notice of displacement and appropriate application forms to each displaced person, business, or farm operation. They will assist in filing applications, review and take action on applications for relocation assistance, review and process grievances, and make relocation payments. (Estimated total project administration cost is $1,830,100.)

Land Rights

The cost of land rights includes the costs for:

1. All expenditures made in acquiring land, easements, leases, and rights-of-way or their value as estimated by the local organization with the concurrence of the Service. Included are such items as the cost of subordination agreements, the cost of complying with special provisions not necessary for the proper construction, operation, or maintenance of works of improvement, and construction and engineering services directly associated with acquisition of land rights.

2. Changes of existing telephone, power, gas, water lines, or other utilities. The principal item will be the relocation of the Monmouth and Falls City water lines.

3. All relocations and changes of highways and roads that are to remain serviceable after project installation including necessary engineering. Relocation cost for the road from Falls City to Camp Kilowan will be limited to the cost to provide access equal to present conditions.

4. Relocation or reconstruction of new fences or guardrails for the protection and safety of the public, except when such measures are necessary for the protection and safety of the public using the recreation developments at the Teal Creek Reservoir site. (Cost of fences and guardrails associated with these developments includes protection around control structures, spillways, and pump houses and are classified as construction costs.)

The total land rights cost is estimated to be $894,580.

Relocation Assistance

The costs for relocation payments ($32,340) will be shared by the Service and the Sponsors. The cost-sharing percentages are based on the ratio of P.L. 566 funds and other funds to the total project costs.

Water Rights

The cost of water rights includes the examination, recording, and storage fees required by the State Engineer of Oregon. Costs are included to cover the expense of preparing the necessary maps and surveys. The estimated water rights cost is $800.

COST ALLOCATION

All structural measures costs, except for project administration, are allocated to the purposes served. The method used for each measure will provide that each purpose shall share equitably in any resulting savings accomplished by inclusion of more than one purpose in a structure. See Table 2A for a summary of cost allocation. The methods used for cost allocation are as follows:

Teal Creek Reservoir

Construction, engineering services, and water rights are allocated by the "Use of Facilities" method. The allocation is as follows: 19.12 percent to flood prevention, 12.43 percent to irrigation, 46.11 percent to recreation, 12.00 percent to fish and wildlife, and 10.34 percent to municipal-industrial water supply.

Cost of land rights are allocated to recreation, irrigation, fish and wildlife, and municipal-industrial water supply. The allocations to the combined storage purposes (irrigation and municipal-industrial water) were made in proportion to the increment of water surface area added for these purposes in relation to the total area required for the dam and reservoir and this allocation then divided to each purpose according to the required capacity for each. The balance is allocated to fish and wildlife and recreation. Total land rights costs are allocated as follows: 66.13 percent to recreation, 10.27 percent to irrigation, 17.20 percent to fish and wildlife, and 6.40 percent to municipal-industrial water supply.

Irrigation Water Distribution System

All costs are allocated to irrigation.

Diversion System

Costs are allocated to flood prevention, irrigation, and municipal-industrial water supply in proportion to the peak design capacity required for each purpose. 88.89 percent will be allocated to flood prevention, 7.85 percent to irrigation, and 3.26 percent to municipal-industrial water supply.

COST SHARING

Installation costs will be shared by local sponsoring organizations and the Federal government in accordance with requirements of Public Law 566, as amended, and the Secretary's policy statement.

LAND TREATMENT MEASURES

Costs for installation of land treatment will be borne by the individual landowners with such assistance as may be available from the Agricultural Conservation Program or other sources of funds.

The costs of technical assistance necessary for the installation of land treatment measures will be borne by going program funds of the Service, the Forest Service, and the State Forestry Department at the rate now being expended for these programs. The costs of accelerated technical assistance above the level of going program funds of the Service will be paid from P. L. 566 funds.

STRUCTURAL MEASURES

Costs will be shared as follows:

Cost Item and Purpose	P. L. 566 Funds %	Other Funds %
Construction		
Flood Prevention	100	0
Recreation & Fish & Wildlife	50	50
Municipal-Industrial Water	0	100
Irrigation	50	50
Engineering Services		
Flood Prevention	100	0
Recreation & Fish & Wildlife		
Reservoir	100	0
Recreation Facilities	50	50
Municipal-Industrial Water	0	100
Irrigation	100	0
Land Rights		
Recreation & Fish & Wildlife		
Land Acquisition	50	50
Relocation of Improvements	50	50
Legal fees, surveys & other related costs	0	100
All other purposes	0	100
Water Rights		
All Purposes	0	100
Relocation Assistance		
All Purposes	59.6	40.4

Using the above percentages, the costs of individual structural measures will be shared by P.L. 566 funds and other funds as follows:

Item	P.L.566 %	Other %	Estimated Cost %
Construction			
Teal Creek Reservoir	54.39	45.61	4,674,960
Diversion System	92.82	7.18	1,365,560
Irrigation Water Distribution System	50.00	50.00	1,214,280
Recreation Facilities			
1.Maintenance Facility	0	100.00	10,000
2.All Other Rec. Fac.	50.00	50.00	583,000
Fish Incubators	0	100.00	4,000
Stream Treatment	50.00	50.00	2,000
Engineering Services			
Teal Creek Reservoir	89.68	10.34	245,500
Diversion System	96.73	3.27	102,590
Irrigation Water Distribution System	100.00	0	121,430
Recreation Facilities	50.00	50.00	59,330
Fish Incubators	0	100.00	400
Stream Treatment	100.00	0	500
Water Rights (All)	0	100.00	800
Land Rights			
Teal Creek Reservoir			
Payment to landowners for about 600 acres	41.67	58.33	335,000
Cost of relocation or modification of improvements	41.67	58.33	121,000
Legal fees, surveying and related costs	0	100.00	45,600
Recreation Facilities			
Payment to landowners for about 258 acres	50.00	50.00	154,800
Legal fees, surveys, and other administrative costs	0	100.00	15,480
All other measures	0	100.00	222,700
Relocation Assistance (All)	59.60	40.40	32,340

See Table 2A for a summary of cost sharing by purposes for structural measures.

Project Administration costs are assigned to the Sponsors and the Service as follows:

Sponsors will bear all costs for local organization administrative cost for contract administration (including all legal fees), and will bear the following percentages of construction surveys and inspection costs: for Teal Creek Reservoir 10.34, Diversion System 3.27, and Irrigation Water Distribution System 0.00.

The Service will bear with P. L. 566 funds the remaining costs for contract administration, construction surveys, and inspections and 100% of Government representatives and miscellaneous administrative costs.

ESTIMATED OBLIGATION OF FUNDS - BY YEARS

	P. L. 566 Funds		Other Funds	
Fiscal Year	Land Treatment	Structural	Land Treatment	Structural
1	$ 6,400	$ 528,610	$ 31,900	$ 363,700
2	9,400	3,278,000	90,700	2,423,300
3	19,400	1,341,180	175,500	766,440
4	20,150	1,847,750	223,300	471,680
5	10,400	110,840	223,300	10,210
6	10,856	--	85,982	--
TOTAL	$76,606	$7,106,380	$830,682	$4,035,330

EFFECTS OF WORKS OF IMPROVEMENT

The installation of the land treatment and project measures will have a major impact on the development and economy of the watershed, on Falls City, on the City of Monmouth, on the City of Dallas, and on Polk County.

Flood damages will be reduced by 54 percent and farm income will be improved and stabilized by the more diversified crop production. There will be a significant impact on business activity in the community, both as a result of a general increase in farm income and through the increased opportunities made possible by the additional water supplies. The recreation developments will both increase the economic activity and assist in providing an attractive place to live.

In addition to the increased development and productivity, the land treatment measures and works of improvement will also conserve, protect, and enhance the environment of the area. These measures will reduce the rates of runoff and of soil loss, thus preserving the land for production. It will provide for an improvement in the water quality of the streams by reducing the amount of sediment that enters the stream system of the watershed, and it will enhance the beauty of forest lands so that people will not be deprived of a suitable streamside environment for recreational use.

LAND TREATMENT MEASURES

Land treatment measures will provide continuing watershed protection on the upper watershed. Practices on cropland areas will provide a foundation for efficient and economic use of the irrigation water supplies and will improve the productivity of the land and decrease the cost of operation.

The application of the land treatment practices is essential for the benefits of the structural measures to be fully realized and for the protection and preservation of the environment.

The cover conditions of the upland and foothill areas are in an excellent hydrologic condition. Most of the project land treatment measures are in the cropland areas, a small percentage of the total watershed, thus the benefits to flood prevention are negligable.

STRUCTURAL MEASURES

FLOOD PREVENTION

The structural measures for flood prevention will eliminate 54 percent of the floodwater damages on the Little Luckiamute River. The Teal Creek Reservoir, diversion system, and keeping Little Luckiamute free of log jams will provide protection from the storm that occurs on the average of about once in 10 years in those areas close to the structural measures to about once in 2 years in those areas not effected by backwater from the Luckiamute River as minimum levels of flood protection. The average annual acres flooded, effected by the works of improvement, will be reduced from 1,657 to 516 acres. Also, the area that is flooded on the average of once in 3 years will be reduced from 1,985 to 632 acres, a reduction of 68 percent. Depth and duration, primary damage factors, of flooding will be reduced on 2,740 acres.

Most of the irrigated cropland will be situated outside of the flood-prone area. However, less frequently flooded portions of the flood plain will be used for irrigated cropland where the crop being grown is seasonally compatible with the occurrence of brief flooding. These crops would include irrigated pasture, sweet corn and bush beans and other summer grown annuals.

Backwater from the Luckiamute River limits the project benefits in the lower reaches of the Little Luckiamute flood plain. However, the reservoir and diversion system will reduce the flood flows on the Luckiamute River at Suver by about 3,500 cfs for the 100-year flood and about 2,600 cfs for the 10-year flood.

Damage and debris removal cost will be significantly reduced on seven bridges in the watershed. Future cost for replacement of road bridges will be substantially reduced because of the decreased flood hazard and the resulting smaller required capacities.

Teal Creek Reservoir will have a storage of 381 acre-feet for sediment. Downstream deposition will be reduced and water quality improved. Flood cleanup costs will be significantly reduced.

IRRIGATION

Project measures will provide the irrigation water supply and a distribution pump and pipeline system to serve 4,100 acres with a reliability of at least 80 percent, or 8 out of 10 years. Project measures are based on the assumption that the water supply will not be sufficient to meet the full irrigation water requirement in all years. During these years, which will occur to some degree less often than 1 year in 5, the operating district will provide less water than required to fully meet the irrigation needs of the 4,100 acres. Individual farm operators will adjust their use of this water within their cropping systems. The nature of the crops to be grown and timing of planting dates will help permit this variation in supply without major damage to crops or serious reduction in income.

Nearly all of the acreage served will be converted from dryland crops, mostly grain and pasture, to a combination of higher value crops including irrigated pasture, specialty seed crops, vegetables, strawberries, and mint.

Areas now dryland farmed will be converted to irrigated crops. SCS PHOTO

Water quality tests of project water supplies show that the water will be of high quality for irrigation use. (See table in Investigations and Analyses Section for composition of cropping system and crop yields before and after project irrigation water is available.)

MUNICIPAL AND INDUSTRIAL WATER

Municipal and industrial water supplies will be stored in the Teal Creek Reservoir. This water will be used to supplement existing water supplies for the City of Monmouth, the Luckiamute Domestic Water Association service area, and to meet the projected needs of other areas in Polk County.

Approximately 35,000 people could be provided their full water needs from this source if it were used exclusively for residential use. The 3,875 acre-feet of municipal-industrial water supply (2,584 joint use and 1,291 single purpose) will have nearly a 100 percent reliability. The yield from the Teal Creek and Little Luckiamute drainage areas is adequate to meet these demands.

RECREATION

The recreation facilities on Teal Creek Reservoir will help satisfy a pressing need for public recreation in Polk County and the surrounding area. At present over 98 percent of the recreation land in this area is privately owned. The development is within easy driving distance of most of the heavily populated areas of Oregon.

A broad spectrum of recreational activities, including both day use and overnight camping is planned. These activities will be spread around most of the shoreline of the reservoir and the adjacent land. Facilities for picnicking, swimming, boating, fishing, athletics, group functions with opportunity for complementary concession outlets for food, boats, and equipment. Trailer and camping facilities and hiking trails will also be provided. Although the planned seasonal operation of the facilities calls for heavy use from May through September, there will be nominal use during the fall and spring months and open winters will permit some year around use of the area.

These facilities will have an expected visitor day use of 420,000 annually, with an initial peak daily use of approximately 6,600. It is anticipated that in the future additional facilities will be constructed to accomodate future additional recreation demand.

These facilities will provide a healthful and attractive recreational environment for the local people and visitors and will increase the economic well being of Falls City, Dallas, and other nearby communities. Although all ages will benefit, the youth of the area in particular will derive physical, social and cultural benefits from these facilties.

The opportunity for associated private recreation opportunities will be enhanced and nearby communities, such as Falls City, will receive a substantial economic boost as a result of the recreation use of Teal Creek Reservoir. Opportunities will improve for sales of goods and services and for sales or rental of vacation home sites, and over-nite facilities.

Water quality tests show that the water is of high quality for recreational use.

F I S H A N D W I L D L I F E

The Teal Creek Dam will block anadromous fish passage up Teal Creek and will inundate approximately 2 miles of spawning area. To mitigate for this, coho salmon and steelhead will be passed over the dam by trap and haul and outlets will be designed to allow the young fish to migrate downstream out of the reservoir.

A resident trout fishery will be provided in the reservoir and will be managed by the Oregon State Game Commission. The Fish Commission of Oregon will manage the reservoir for rearing young Chinook salmon to migrating size and thereby enhance the run of these fish for the widespread benefit of downstream sport and commercial fisheries.

Some upland and small game habitat will be lost in the reservoir area. Habitat improvement and preservation measures will be encouraged to compensate for their loss. An example is the installation of wood duck nest boxes at suitable locations around the reservoir. Any unused project lands should be developed for permanent food and cover for wildlife.

The reservoir area is expected to provide a resting area for waterfowl wintering in the area. The exact effects of changes in cropping patterns on wildlife as a result of project irrigation water is unknown. Conservation planning will include measures for encouraging wildlife in the project area.

INCIDENTAL EFFECTS

The reservoir will provide an additional water supply for fire protection. The project's regulating effect on the streamflow will reduce ponding on overflow areas and will contribute to a reduction in the number of mosquitoes.

The diversion from Little Luckiamute River may pass many of the migrating anadromous fish smolts through the Teal Creek Reservoir. These fish are the result of surplus mature fish stocked above the falls on the Little Luckiamute River where they spawn.

The displacements brought about by construction of Teal Creek Reservoir and recreation facilities will not have any significant detrimental effects on the economy or environment of this area.

PROJECT BENEFITS

PRIMARY BENEFITS

LAND TREATMENT MEASURES

Benefits from land treatment measures will be primarily on-site conservation benefits accruing from more efficient management of land and water. No monetary evaluation was made for these measures.

STRUCTURAL MEASURES

Flood Prevention

The primary flood damage reduction benefits resulting from the installation of project measures include $38,610 direct benefits and $4,700 indirect benefits. Benefits from more intensive land use will be $78,625. Total average annual primary flood prevention benefits will be $121,935.

Agricultural Water Management (Irrigation)

Estimated average annual primary benefits from irrigation measures will be $159,055 after deduction of associated costs.

Municipal and Industrial Water

Estimated average annual primary benefits from municipal-industrial water measures will be $61,200 after deduction of associated costs.

Recreation

The estimated benefits for recreation are based upon an initial development providing 420,000 visitor days annually. Included in these visitor day estimates is an initial angling usage of 22,000 angler-days on the reservoir for trout. Each visitor day is valued at $1.50. The average annual benefit is $630,000.

Fish Enhancement

Benefits resulting from anadromous fishery enhancement include $17,640 from commercial fishing and $22,500 from the sports fishing, for an average annual total benefit of $40,140.

SECONDARY BENEFITS

Local secondary benefits will be equal to 10 percent of the increased production costs (including operation and maintenance costs) and 10 percent of the direct primary benefit. Estimated average annual secondary benefits will be $168,420.

Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation and were not included in the benefit-cost analysis.

UNEVALUATED BENEFITS

The installation of the land treatment and structural measures will encourage additional interest in conservation of the resources of the watershed and will help to stabilize the economy of this area. It will also promote further capital improvements, increase employment, help maintain a higher standard of living, and contribute to the general welfare of the community and the state. It will also provide benefits from the conserving and enhancing of the environment by keeping the soil in place, protecting the quality of the water, and maintaining the esthetic beauty of the countryside.

Benefits of improved fire protection were not evaluated monetarily.

Benefits will also result from the reduced peak flows and flood stages on the Luckiamute River below the outlet of the watershed. These reductions were not evaluated but show that there is an inter-relationship between the upstream and downstream areas.

No evaluation was made of the reduction in sediment delivered downstream. However, since the watershed is in an excellent cover conditions, it is expected that this reduction would be small.

COMPARISON OF BENEFITS AND COSTS

The ratio of average annual benefits of structural measures, $1,201,810 to the average annual cost of these measures, $729,290 is 1.6 to 1. This ratio is based on 1970 prices for installation costs and on adjusted normalized prices for benefits, operation, and maintenance.

The ratio without the inclusion of secondary benefits is 1.4 to 1.

Average annual costs, benefits, and comparison of benefits and costs are shown in Tables 4, 5, and 6.

Strawberries illustrate a high intense use of cropland that provides summer employment for local youth. SCS PHOTO 7-2865-11

PROJECT INSTALLATION

INSTALLATION PERIOD

The project measures will be installed progressively within a 6-year period. Installation of land treatment measures will be pursued in a systematic manner during construction of the project structural measures. During the first 2 years of project installation, most land treatment activity will be confined to completion of soil surveys and development of conservation plans. A major portion of the application of land treatment practices above project structural measures will be installed prior to installation of the structural measures. Application of measures to improve water control and distribution will be completed concurrently with the structural measures. Additional land treatment practices to allow a higher degree of management will be started prior to the installation of structural measures and completed concurrently with them.

The scheduled obligation of funds shown in the "Explanation of Installation Costs" section is based on the following proposed construction schedule:

	Fiscal Year Initiated	
	Engineering Services	Construction
Teal Creek Reservoir	1	2
Diversion System	2	3
Irrigation Water Distribution System	2	3
Recreation Facilties	3	4

INSTALLATION RESPONSIBILITIES

LAND TREATMENT MEASURES

The installation of land treatment measures will be the responsibility of the individual landowners or operators.

Technical assistance for planning and application of land treatment measures will be furnished by the Soil Conservation Service, the Forest Service, and the State Forestry Department to the landowners or operators through the Polk Soil and Water Conservation District.

It will be the responsibility of the Soil and Water Conservation District to obtain agreements from owners of not less than 50 percent of the land above the reservoir that they will carry out conservation plans on their land. The District will also encourage the development and installation of conservation farm and ranch plans on a high percentage of the land to be benefited by project measures. They will be responsibile for providing leadership in an educational program to encourage the application of land treatment measures necessary to the success of this plan. The district will work closely with the county, cities and other public agencies to encourage adequate land use planning, zoning, land treatment on public lands, and the inclusion of protective measures as a requirement in building and other development permits.

STRUCTURAL MEASURES

Federal assistance for carrying out the works of improvement as described in this plan will be provided under authority of the Watershed Protection and Flood Prevention Act, P.L. 566, as amended.

The installation of all structural measures except the Teal Creek recreation facilities will be the responsibility of the Little Luckiamute Water Control District. Installation of the Teal Creek recreation facilities will be the responsibility of Polk County. The Little Luckiamute Water Control District will be responsible for working with the Service in the construction of all structural measures except the recreational facilities. For the recreational facilities, Polk County will be responsible for working with the Service in the construction of these facilities.

The engineering services for Teal Creek Reservoir will be the responsibility of the Little Luckiamute Water Control District. It is planned to contract for engineering services for design of this structure.

The engineering services for the recreation facilities will be the responsibility of Polk County. Service personnel will assist as available on site location, design, and supervision of construction. It is planned to negotiate for private architectural and engineering services for the major design and related engineering services necessary for installation of these facilities.

All engineering and legal services related to the acquisition of land rights, including the relocation of utilities, will be the responsibility of the local sponsoring organization with assigned responsibility for construction of the project measures. Assistance on these services will be obtained by agreement with the appropriate road department, utility company, other sponsor, or other agency. Polk County will assist the Little Luckiamute Water Control District on land appraisals and other services related to the acquisition of land rights and utility relocations for the Teal Creek Reservoir.

The local sponsoring organizations request that the Service administer all construction contracts and negotiate and administer engineering services contracts.

Relocation advisory services will be furnished by Polk County with assistance from the Little Luckiamute Water Control District and the Service. The Sponsors have determined that decent, safe, and sanitary replacement dwellings will be available prior to construction of Teal Creek Reservoir. Polk County will: (1) Provide personally or by first class mail, written notice of displacement and appropriate application forms to each displaced person, business or farm operation, (2) assist in filing applications, (3) review and take action on applications for relocation assistance, (4) review and process grievances in connection with displacements, and (5) make relocation payments.

P.L. 566 assistance for structural works of improvement (other than information for obtaining land, easements, and rights-of-way) will not be made available until the sponsoring local organization has acquired lands, easements, and rights-of-way or options sufficiently in advance of the scheduled installation of the works of improvement to provide a reasonable basis for the orderly design and construction of these measures.

The following minimum conditions shall be met before issuance of invitations to bid on any portion of construction:

1. The necessary acquisition of land and easements and the relocation of utilities will be assured by the sponsors. The project sponsors have the power of eminent domain and agree to use such authority if necessary. Therefore, Federal assistance for construction may be provided before all easements and rights-of-way for the entire project are obtained. In such cases, specific agreements on obtaining all necessary land, easements, and rights-of-way shall be reached and the willingness of the sponsors to exercise their authority reaffirmed.

2. Mutual agreements on the schedule for construction and on plans and specifications shall be reached. Terms of contracts and all matters pertaining to contracts or to works of improvement shall be mutually satisfactory and

in accordance with requirements of the sponsors and in agreement with the Soil Conservation Service technical and Administrative requirements.

3. Full conformance with state and Federal laws and regulations shall be the responsibility of the sponsors and shall be secured with no expenditure of P.L. 566 funds. Reasonable evidence of conformity shall be presented to the mutual satisfaction of all parties.

4. Agreements for operation and maintenance of the structural measures shall be secured.

METHODS OF INSTALLATION

The contracts for construction will be let by competitive bid and engineering contracts will be negotiated, except in cases where a formal construction contract is determined to be impractical and construction under force account can more reasonably be used. Force account operations may be used on construction elements where it is not feasible to perform sufficient engineering studies in order to prepare detailed plans and specifications. Force account may also be used where it is not practical or feasible for the local organization to provide cash for all the local share of the cost. Sponsors may in these cases be able to perform certain elements of the project work with their own force or with contributed labor, equipment, and materials in lieu of providing cash. When these conditions exist, the State Conservationist may approve force account arrangements. The provisions of the force account work will be included in the project or engineering agreement which will be mutually agreed to immediately prior to initiation of the concerned work.

FINANCING PROJECT INSTALLATION

Project installation costs allocated to P.L. 566 funds will be paid from funds appropriated under the authority of Public Law 566, 83d Congress; 68 Stat. 666, as amended. This work plan does not constitute a financial document for obligation of P.L. 566 or other funds. Financial or other assistance to be furnished by the Service in carrying out the plan is contingent on the appropriation of funds for this purpose.

All sponsors have participated in cost sharing decisions and have given assurances that their share of the installation cost will be available as indicated in the plan. The Little Luckiamute Water Control District and Polk County are the local sponsoring organizations with responsibility for the installation of structural measures. Both have the authorities necessary to borrow or otherwise raise money to finance the local share of project costs. Their authorities include the ability to enter into contracts with the Federal Government, other sponsors, and with other agencies to obtain financial assistance.

The Little Luckiamute Water Control District was organized during planning for this project. The District has raised funds to pay organizational costs and to assist in development of the project plan.

LAND TREATMENT

The cost of land treatment measures will be borne by the individual landowners or operators with such assistance as may be available from the Agricultural Conservation Program or other funds.

Technical assistance will be provided by the Soil Conservation Service, by going program funds, and from P.L. 566 funds for accelerated assistance in excess of the going program rate.

On private forest land technical assistance will be provided by the State Forester and financed from regular program funds appropriated by the State Legislature and from P.L. 566 funds for accelerated assistance in excess of the going program rate. The Forest Service will provide technical assistance on fire prevention with regular program funds.

STRUCTURAL MEASURES

The Little Luckiamute Water Control District and Polk County plan to use the loan provision of Public Law 566 to finance their share of the installation costs for structural measures including Teal Creek Reservoir, the diversion system, the irrigation water distribution system, and recreation facilities. Loan funds will be used for obtaining landrights and for relocation payments and relocation advisory services.

Representatives of the Farmers Home Administration have participated in meetings of the County and the District and a preliminary application for a P.L. 566 loan has been submitted by the District and by the County to the State Director of FHA. Part of these funds will be used to acquire land rights on approximately 957 acres of land, including 600 acres for the Teal Creek Reservoir, 258 acres for the recreation facilities, 20 acres for the diversion system, and 79 acres for the irrigation water distribution system. The District has requested a loan of $1,200,000 to finance their portion of the project. These funds will be used to assist in paying for their share of the installation costs for the Teal Creek Reservoir, Diversion System, and the Irrigation Water Distribution System. The County has requested a loan of $1,700,000 to finance their portion of the project. These funds will be used to assist in paying for their share of the installation costs for the Teal Creek Reservoir, Diversion System, and the Recreation Facilities. The amounts of the loans will be adjusted as future needs are determined.

The sponsors will repay this loan and obtain necessary funds for operation, maintenance, and replacement from assessments based on flood prevention benefits, recreation user fees, and from contracts for the purchase of irrigation and municipal and industrial water supplies. The sponsors will seek financial assistance from the Oregon State Marine Board and the Oregon State Game Commission on items of installation where these agencies have interests.

Agreements entered into with these agencies will be noted in the project agreements signed prior to letting contracts for structural measures.

Polk County plans to use the provisions of P.L. 566 permitting an advance of P.L. 566 funds for financing future municipal and industrial water supplies. An advance of $360,000 will be used to meet the construction costs for a capacity of 2,875 acre feet of future municipal water. This will not exceed 30 percent of the total installation cost of the structure.

Polk County will enter into an agreement for repayment of the advance to the Farmers Home Administration prior to the execution of the project agreement.

The county intends to use the water from this storage capacity in approximately 10 years. The State Director of the Farmers Home Administration has tentatively concurred in this proposed advance of funds.

The City of Monmouth will finance those costs associated with 1,000 acre feet of municipal water for the City of Monmouth through revenue bonds. These bonds to be retired through the sale of water in the City of Monmouth. This supply will be for immediate use by the city.

PROVISIONS FOR OPERATION, MAINTENANCE AND REPLACEMENT

LAND TREATMENT

Land treatment measures will be maintained by the landowner or operator. Technical assistance will be provided by the Soil Conservation Service, the Forest Service, and the Oregon State Forestry Department through the going programs of assistance to the Soil and Water Conservation Districts.

STRUCTURAL MEASURES

The operation and maintenance of the recreation facilities on the Teal Creek reservoir will be the responsibility of Polk County. The operation and maintenance of all other structural measures will be the responsibility of the Little Luckiamute Water Control District.

Inspections of works of improvement will be made annually and after every major flood for the first three years of operation by representatives of the Soil Conservation Service and the sponsors. The inspections will be made by representatives of the sponsors after the third year.

Specific operation and maintenance agreements between the sponsors and the Soil Conservation Service will be executed before the land rights agreement or a project agreement is executed.

Operation and maintenance of the structural measures shall conform to all appropriate local, State, and Federal regulation. Representatives of the Federal, State, and local governments shall have free access at all times to the structural measures for official activities.

Operation of the structures shall include, but not be limited to:

1. Operating the Teal Creek Reservoir for flood prevention, irrigation, recreation, fish and wildlife, and municipal water supply. The operation includes programming the

reservoir releases to obtain flood prevention and fish benefits and to fill the storage capacity. The storage capacity to be jointly used for water supply and flood prevention will be left vacant until the hazard of major floods has passed and will then be filled according to a specific plan which will be detailed in the O&M agreement entered into between the District and the Service prior to construction of the reservoir. The stored waters will not be withdrawn below the recreation and fish pool elevation 369.5 msl, except for the withdrawal of 50 acre-feet to satisfy the landscaping and vegetative needs of the recreation development. The local organization is responsible for notifying the Soil Conservation Service through the State Conservationist whenever the reservoir is operated differently than the specified ranges, and jointly with the Service determine if there is a continuing need to do so.

2. Operating pumps and controls to regulate flows in the distribution systems to meet water supply needs.

3. Removing the debris from the reservoir, diversion system, and from distribution system structures.

4. Maintaining existing capacities in natural channels for flood prevention by controlling weeds and undesirable free growth, removal of sediment accumulation, and removal of debris jams.

5. Operating the recreation facilities associated with the Teal Creek Reservoir. The recreation developments, including use of the reservoir area and associated recreational facilities will be operated by Polk County for use of the general public.

   Operation of these facilities will include necessary custodial, policing, sanitation, and safety services. The operation of the reservoir for recreation will be planned in consultation with the Oregon State Game Commission and the Oregon State Marine Board to assure compatibility of fishing and boating with other proposed uses. Power board regulations will be exercised when conditions require controls. Disposal of waste materials from boats will be prohibited.

   Polk County will enter into an operation and maintenance agreement with the Little Luckiamute Water Control District for operation of the reservoir for recreational use prior to letting a construction contract. The operation of the reservoir will be coordinated with the Oregon State Department of Forestry to meet fire protection needs of the area.

Admission and use fees may be charged for portions of the recreational development. The schedule of admission and use fees together with other requirements for operation and maintenance of the recreation facilities must be mutually agreed to by the sponsors and the Service and set forth in the operation and maintenance agreement. Prior approval by the Farmers Home Administration must also be obtained if watershed loan funds obtained for the recreation facilities are expected to be repaid from project revenue.

Polk County and the Little Luckiamute Water Control District will enter into an agreement with the Oregon State Game Commission for operation and maintenance of the reservoir fishery, and with the Fish Commission of Oregon and Oregon State Game Commission for operation of the anadromous fish handling facilities.

The state and local public health agencies will be consulted with the plans for operation of the recreation facilities to assure that operations will meet adequate health standards.

6. Operation of anadromous fish mitigation facilities at Teal Creek Reservoir will include all functions necessary to trap and hold adult fish. It also includes operating the principal spillway and the emergency spillway to provide the maximum amount of water for egress of young anadromous fish from the reservoir in April, May, and June. The Little Luckiamute Water Control District will be responsible for operation of mitigation facilities. The District expects to contract with the state fishery agencies for actual performance of the work.

Maintenance of facilities shall include, but not be limited to:

1. Keeping all structures in serviceable condition by making replacements and repairs as needed.

2. Maintaining adequate capacity in natural and constructed channels by controlling weeds and undesirable tree growth, removal of sediment accumulation, and removal of debris jams.

3. Check the pipelines and appurtenances after each irrigation season; make the necessary repairs including replacement of eroded earth cover.

4. Removal of sediment from water control and pump structures to maintain required capacities.

5. Maintaining vegetative cover and rock riprap where needed.

6. Maintaining the recreational facilities. Maintenance will include keeping all facilities including roads, parking areas, and boat launching ramps in serviceable condition by making repairs and replacements as needed.

7. Maintenance of the reservoir fishery by periodic restocking and chemical treatment as necessary.

8. Maintenance of the mitigative anadromous fish facilities as required through agreements with the Fish Commission of Oregon.

Estimated Annual Operation, Maintenace, and Replacement Costs:

Structure	Estimated Annual 1/
Teal Creek Reservoir	$18,460
Diversion System	3,240
Irrigation Water Distribution System	35,500
Recreation Facilities	67,150
Little Luckiamute Channel Maintenance	3,160

1/ Adjusted normalized prices.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Little Luckiamute River Watershed, Oregon

Installation Cost Item	Unit	Number 2/	Estimated Cost (Dollars) 1/		
			P. L. 566 Funds	Other Funds	Total
LAND TREATMENT MEASURES					
Soil Conservation Service					
Cropland	Acres	7,000	-	758,520	758,520
Grassland	Acres	470	-	13,880	13,880
Technical Assistance	-	-	67,406	6,052	73,458
Subtotal - SCS		-	67,406	778,452	845,858
Forest Service					
Woodland	Acres	1,140	-	2,400	2,400
Fire Protection	Acres	43,160	5,000	47,130	52,130
Technical Assistance	-	-	4,200	2,700	6,900
Subtotal - FS	-	-	9,200	52,230	61,430
TOTAL LAND TREATMENT	-	-	76,606	830,682	907,288
STRUCTURAL MEASURES					
Construction					
Soil Conservation Service					
Teal Creek Reservoir	No.	1	2,542,710	2,132,250	4,674,960
Fish Incubators	No.	1	--	4,000	4,000
Stream Treatment	No.	1	1,000	1,000	2,000
Diversion System	No.	1	1,267,445	98,115	1,365,560
Irrigation Water Distribution System	No.	1	607,140	607,140	1,214,280
Recreation Facilities	No.	1	291,670	301,670	593,340
Subtotal - Construction	-		4,709,965	3,144,175	7,854,140

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Little Luckiamute River Watershed, Oregon

Installation Cost Item	Unit	Number[2/]	Estimated Cost (Dollars)[1/] P.L.566 Funds	Other Funds	Total
Engineering Services	-	-	465,955	63,795	529,750
Project Administration					
Construction Supervision	-	-	821,900	-	821,900
Relocation Assistance Advisory Services	-	-	-	3,600	3,600
Other	-	-	821,900	182,700	1,004,600
Subtotal - Project Administration	-	-	1,643,800	186,300	1,830,100
Relocation Payments	-	-	19,270	13,070	32,340
Other Costs					
Land Rights	-	-	267,390	627,190	894,580
Water Rights	-	-	-	800	800
Subtotal - Other	-	-	267,390	627,990	895,380
TOTAL STRUCTURAL MEASURES	-	-	7,106,380	4,035,330	11,141,710
TOTAL PROJECT	-	-	7,182,986	4,866,012	12,048,998

1/ 1970 Price Base

2/ All works of improvement will be installed on non-Federal land

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

(AT TIME OF WORK PLAN PREPARATION)

Little Luckiamute River Watershed, Oregon

Measures	Unit	Applied To Date	Total Cost 1/
Conservation Cropping System	Acres	1,737	2,605
Contour Farming	Acres	100	50
Land Clearing	Acres	0	0
Irrigation Sprinkler Systems	No.	40	405,000
Irrigation Water Management	Acres	700	1,400
Tile Drainage	Lin. Ft.	720,000	21,600
Streambank Protection	Lin. Ft.	200	200
Stream Channel Improvement	Lin. Ft.	600	600
Irrigation Pipelines	Lin. Ft.	1,500	1,350
Woodland Improvement	Acres	1,820	41,629
Woodland Fire Protection	Acres	43,160	7,855 2/
Hay and Pasture Management	Acres	200	800
Hay and Pasture Planting	Acres	100	4,000
TOTAL			487,089

1/ Current dollar rates.
2/ Cost per year

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Little Luckiamute River Watershed, Oregon

(Dollars) 1/

Item	Installation Cost - P.L. 566 Funds					Installation Cost - Other Funds						Total Installation Cost
	Construction	Engineering	Land Rights	Relocation Payments	Total P.L. 566	Construction	Engineering	Land Rights	Water Rights	Relocation Payments	Total Other	
Teal Creek Res.	2,542,710	220,120	189,990	19,270	2,972,090	2,132,250	25,380	311,610 2/	800	13,070	2,483,110	5,455,200
Fish Incubators	-	-	-	-	-	4,000	400	-	-	-	4,400	4,400
Stream Treatment	1,000	500	-	-	1,500	1,000	-	-	-	-	1,000	2,500
Diversion System	1,267,445	99,240	-	-	1,366,685	98,115	3,350	201,050	-	-	302,515	1,669,200
Irrigation Water Distribution Sys.	607,140	121,430	-	-	728,570	607,140	-	21,650	-	-	628,790	1,357,360
Recreation Facilities	291,670	24,665	77,400	-	393,735	301,670 3/	34,665	92,880 4/	-	-	429,215	822,950
Subtotal	4,709,965	465,955	267,390	19,270	5,462,580	3,144,175	63,795	627,190	800	13,070	3,849,030	9,311,610
Project Administration					1,643,800						186,300	1,830,100
TOTAL					7,106,380						4,035,330	11,141,710

1/ Price base 1970
2/ Includes $96,000 for road relocation, $5,000 for powerline relocation, $20,000 for relocation of Monmouth and Falls City waterlines, and $45,600 for survey, legal fees and other related costs.
3/ Includes $10,000 for maintenance facility.
4/ Includes $15,480 for survey, legal fees and other related costs.

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TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Little Luckiamute River Watershed, Oregon

(Dollars) 1/

Item	Cost Allocation - Purpose					
	Flood Prevention	Irrigation	Recreation	Fish and Wildlife	M&I Water	Total
Teal Creek Reservoir	947,120	667,250	2,615,820	680,710	544,300	5,455,200
Fish Incubators	-	-	-	4,400	-	4,400
Stream Treatment	-	-	2,500	-	-	2,500
Diversion System	1,483,745	131,030	-	-	54,425	1,669,200
Irrigation Water Distribution System	-	1,357,360	-	-	-	1,357,360
Recreation Facilities	-	-	822,950	-	-	822,950
TOTAL	2,430,865	2,155,640	3,441,270	685,110	598,725	9,311,610

1/ *Price Base 1970*

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TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY (continued)

Little Luckiamute River Watershed, Oregon

(Dollars) 1/

Item	Cost Sharing											
	P. L. 566						Other					
	Flood Prevention	Irrigation	Recreation	Fish & Wild-life	M&I 2/ Water	Total	Flood Preven-tion	Irrigation	Recreation	Fish & Wild-life	M&I Water	Total
Teal Creek Reservoir	944,470	323,470	1,350,675	351,485	1,990	2,972,090	2,650	343,780	1,265,145	329,225	542,310	2,483,110
Fish Incubators	-	-	-	-	-	-	-	-	-	4,400	-	4,400
Stream Treatment	-	-	1,500	-	-	1,500	-	-	1,000	-	-	1,000
Diversion System	1,305,035	61,650	-	-	-	1,366,685	178,710	69,380	-	-	54,425	302,515
Irrigation Water Distribution System	-	728,570	-	-	-	728,570	-	628,790	-	-	-	628,790
Recreation Facilities	-	-	393,735	-	-	393,735	-	-	429,215	-	-	429,215
TOTAL	2,249,505	1,113,690	1,745,910	351,485	1,990	5,462,580	181,360	1,041,950	1,695,360	333,625	596,735	3,849,030

1/ Price base 1970

2/ P.L. 566 costs include $1,990 of Relocation Payment cost allocated to M & I Water.

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TABLE 2B - RECREATION FACILITIES

ESTIMATED CONSTRUCTION COST
(Dollars) 1/

Little Luckiamute River Watershed, Oregon

Item	Unit	Number	Estimated Unit Cost	Construction Cost
Roads				
2-Lane Asphalt	ft.	11,000	10.00	110,000
1-Lane Asphalt	ft.	10,000	6.00	60,000
Trails	mi.	6	2,000.00	12,000
Parking Areas				
Asphalt	ac.	5	12,000.00	60,000
Sod	ac.	10	500.00	5,000
Tables (treated wood)	no.	420	50.00	21,000
Fireplaces	no.	100	50.00	5,000
Shelters	no.	5	7,000.00	35,000
Restrooms				
10 unit	no.	4	8,000.00	32,000
8 unit	no.	2	6,000.00	12,000
Sewer Line	ft.	4,000	2.50	10,000
Septic Tank & Drain Field	no.	4	3,000.00	12,000
Beach Dev. (sand & revetment)	no.	1	10,000.00	10,000
Bath House	no.	1	20,000.00	20,000
Swimming Dock	no.	2	1,200.00	2,400
Log Booms	ft.	1,500	1.00	1,500
Boat Ramp	no.	1	10,000.00	10,000
Boat Dock	no.	1	5,000.00	5,000
Irrigation System	ac.	30	1,000.00	30,000
Fencing	ft.	10,000	1.00	10,000
Clearing and Planting	ac.	20	1,000.00	20,000
Signs	lump	-	-	1,500
Public Water Supply System	lump	-	-	20,000
Power Facilities & Lighting	lump	-	-	15,000
Sewage & Waste Dumping Station	no.	1	10,000.00	10,000

TABLE 2B - RECREATION FACILITIES

ESTIMATED CONSTRUCTION COST
(Dollars) 1/

Little Luckiamute River Watershed, Oregon

Item	Unit	Number	Estimated Unit Cost	Construction Cost
Maintenance Facility	no.	1	10,000.00	10,000 2/
Subtotal				539,400
Contingencies				53,940
TOTAL				593,340

1/ *1970 Price Base*

2/ *Ineligible for cost sharing assistance.*

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TABLE 3 - STRUCTURE DATA

MULTIPLE PURPOSE RESERVOIR

Little Luckiamute River Watershed, Oregon

Item	Unit	Teal Creek
Class of Structure		"C"
Drainage Area	Sq. mi.	9.83 (40.17) [1]
Curve Number (1 day)		80
Tc	Hrs.	4.0
Elevation Top of Dam	Ft.(msl)	400.7
Elevation Crest Emergency Spillway	Ft.(msl)	395.1
Elevation Crest Principal Spillway	Ft.(msl)	374.6
Maximum Height of Dam	Ft.	110
Volume of Fill	Cu. yds.	4,040,000
Total Capacity	Ac. ft.	25,000
Irrigation [2]	Ac. ft.	6,216
M&I [3]	Ac. ft.	3,875
Fish Pool	Ac. ft.	3,000
Recreation Pool	Ac. ft.	11,528
Submerged Sediment	Ac. ft.	381
Retarding Capacity [4]	Ac. ft.	8,800
Surface Area		
Sediment Pool	Ac.	50
Floodwater Pool at Crest of Emergency Spillway	Ac.	440
Irrigation Pool	Ac.	440
Recreation & Fish Pool	Ac.	340
M&I	Ac.	360
Principal Spillway		
Runoff Volume (1 day)	In.	5.1
Runoff Volume (10 day)	In.	22.0
Capacity	cfs	245 (low stage & 1900 (high stage)
Frequency of Operation of Emergency Spillway	%	1

TABLE 3 - STRUCTURE DATA

MULTIPLE PURPOSE RESERVOIR

Little Luckiamute River Watershed, Oregon

Item	Unit	Teal Creek
Emergency Spillway		
Rainfall Volume (ESH) (areal)	In.	21.4
Runoff Volume (ESH)	In.	18.27
Type		Concrete Chute
Crest Length	Ft.	105
Maximum Water Surface Elevation	Ft.	399.1
Freeboard Spillway		
Rainfall Volume (FH) (areal)	In.	34.91
Runoff Volume (FH)	In.	31.36
Type		Concrete Chute
Crest Length	Ft.	105
Maximum Water Surface Elevation	Ft.	400.7
Capacity Equivalents		
Sediment Volume	In.	.72(.18)
Retarding Volume	In.	16.8 (4.1)
Spillway Storage	In.	4.57(1.12)

1/ Numbers in parenthesis reflect addition of 30.34 sq. mi. drainage area at point of diversion system.
2/ All joint use with floodwater retarding capacity.
3/ 2,584 acre feet joint use with flood prevention.
4/ Joint use with irrigation and M & I

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TABLE 3A - STRUCTURE DATA

IRRIGATION WATER DISTRIBUTION SYSTEM

Little Luckiamute River Watershed, Oregon

Acres Served 4,100

Pipe Diameter	Feet	Pumping Plant	Plant HP
39"	2,650	R-1	450
36"	8,200	R-2	150
		R-3	150
30"	12,120	B-35	15
28"	4,520	B-33	10
26"	3,840	B-30	15
24"	6,300	D M-1	30
22"	21,060	D M-2	20
20"	9,700	E-8	7½
18"	10,540	E-6	10
16"	6,820	E-4	1
14"	9,550	E-3	2
12"	8,170	F-2	3
10"	9,110	F-3	5
8"	5,040	F-5	10
6"	3,850	F-6S	50
5"	1,000	F-7M	20
4"	2,550	F-9S	40
	124,520	18	988½

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TABLE 3B - STRUCTURE DATA

DIVERSION SYSTEM

Little Luckiamute River Watershed, Oregon

Channel Name	Station or Reach	Capacity		Canal Gradient	Canal 1/ Dimensions		Velocities	Excavation	Backfill	Concrete 2/
		Req'd	Design		Bottom	Depth				
	100 feet	cfs		ft./ft.	ft.	ft.	fps	cu.-yds.	cu.-yds.	cu.-yds.
Diversion Canal	6+66 to 10+80	2,000	2,000	.0025	14	11	14.5			
	10+80 to 69+20	1,200	1,200	.0025	14	8	12.2			
	69+20 to 80+20	1,200	1,200	.029	14	3	28.6			
								121,840	76,900	9,380

1/ Side slopes: vertical for all portions of the canal.

2/ Includes 500 cu-yds. of concrete for the diversion dam across Little Luckiamute and 610 cu-yds. of concrete for roadways and culvert crossings.

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TABLE 4 - ANNUAL COST

Little Luckiamute River Watershed, Oregon

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation Maintenance Cost	Total
All Structural Measures	503,200	127,510 3/	630,710
Project Administration	98,900	-	98,900
GRAND TOTAL	602,100	127,510	729,610

1/ Price Base: Installation 1970; O&M Adjusted Normalized.

2/ 100 years @ 5-3/8 percent interest.

3/ Inclues $67,150 for operation, maintenance and replacement for the recreational developments.

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TABLE 5

ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Little Luckiamute River Watershed, Oregon

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Floodwater and Related Sediment			
Crop and Pasture	42,780	23,240	19,540
Other Agricultural	16,690	5,860	10,830
Roads and Bridges	12,010	3,770	8,240
Subtotal	71,480	32,870	38,610
Indirect	8,350	3,650	4,700
TOTAL	79,830	36,520	43,310

1/ *Adjusted Normalized Prices.*

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Little Luckiamute River Watershed, Oregon

(Dollars) 1/

Evaluation Unit	Average Annual Benefits 1/								Average Annual Cost 2/	Benefit: Cost Ratio
	Damage Reduction	More Intensive Land Use	Irrigation	Fish & Wildlife	Municipal Water Supply	Recreation	Secondary	Total		
All Structural Measures	43,310	78,625	159,055	40,140	61,200	630,000	189,480	1,201,810	630,710	1.9:1
Project Administration	-	-	-	-	-	-	-	-	98,900	
GRAND TOTAL	43,310	78,625	159,055	40,140	61,200	630,000	189,480	1,201,810	729,610	1.6:1

1/ *Adjusted Normalized Prices.*
2/ *From Table 4.*

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Investigations and Analyses Section

LITTLE LUCKIAMUTE RIVER WATERSHED WORK PLAN

October 1971

INVESTIGATIONS

HYDROLOGY

Hydrologic investigations were made to determine peak flows, annual yields, runoff patterns, 10-day runoff volumes, occurrence of flooding, precipitation data and evaporation data for use in planning multiple-purpose reservoirs, stream channel improvements and irrigation measures.

Principal sources of data used in these investigations include: streamflow data, U. S. Geological Survey Water Supply Papers and State of Oregon Surface Water Records; and climatological data, U. S. Weather Bureau Climatic Summaries, Technical Papers, Hydrometeorological Reports and State of Oregon Precipitation Records.

Soils information was obtained from current soil surveys being conducted by the Soil Conservation Service. Land use was obtained from information developed by the Soil Conservation Service, aerial photos and topographic maps.

GEOLOGY

SURFACE INVESTIGATIONS

Surface investigations include a survey of the regional geology and detailed, limited-area geologic mapping of structure centerlines, reservoir areas, and borrow locations. A generalized watershed map was prepared from previous reports by other agencies with additional field checks at selected locations and is intended to show the overall watershed conditions, sedimentation, and construction materials.

Detailed structure site geologic maps were prepared for structure design and borrow location. These maps were prepared on aerial photographs and large scale topographic maps. Geologic data was obtained from rock outcrops, road cut exposures, geomorphic patterns, previously published material, and stereographic interpretation of aerial photographs.

SUBSURFACE INVESTIGATIONS

Information on subsurface conditions was obtained by core drilling operations, backhoe excavation, and seismic and resistivity surveys. Centerline structure cross sections were developed from these data to show stratigraphy, structure, weathering, permeable zones, and overall foundation rock conditions. These were then used as a basis for foundation design, seepage cutoff, and reservoir seepage loss estimates.

Drilling operations included four core holes on the abutments and floodplain section of the Teal Creek site along the centerline. These holes were pressure tested with both holding and flow tests. Penetration tests were made and core and push tube samples were recovered and tested for permeability and mechanical composition. Continuous grab samples were also obtained.

Backhoe operations included 11 pits excavated along the Teal Creek centerline. Both disturbed and undisturbed samples were obtained for laboratory analysis. These pits varied from 5 to 18 feet in depth and exposed the upper alluvial sections, water table levels, and seepage zones.

Seismic and resistivity surveys were made along the abutments and floodplain sections to extend drill hole information.

CONSTRUCTION MATERIALS INVESTIGATION

Construction materials investigations were limited to backhoe excavations and drill holes along the centerline. Borrow was sampled and laboratory analyses were made of permeability, strength, and mechanical size ranges. Volume of embankment material was estimated from the inspection of soil profiles, stream cuts and road cuts within the reservoir area. Quarry rock estimates were made from outcrop examinations and local quarry operations. Quality and quantity of all required materials were determined from these investigations to provide a basis for project design and cost analysis.

SEDIMENTATION INVESTIGATIONS

Sediment yield rates for the watershed were obtained from values listed by Flaxman and High (1955, Sedimentation in Drainage Basins of the Pacific Coast States) with additional field observations

in selected areas. Sediment deposition was located by visual inspection of the floodplain areas and from interviews with farm operators.

The 100-year sediment storage requirement was determined by using an average sediment yield rate of 0.4 acre feet per square mile for the 9.83 square mile drainage area above the site. The site trap efficiency is computed to be 97 percent using the capacity-inflow method. Total required sediment capacity will be 381 acre feet.

ENGINEERING

RESERVOIR SURVEYS

The following surveys were made to develop data for planning the reservoirs proposed in this plan. Vertical and horizontal control was set on Teal Creek Reservoir for use with U. S. Army Corps of Engineers photography. A kelsh map with a 10-foot contour interval and a horizontal scale of 1 inch = 400 feet and 1 inch = 500 feet was plotted to be used for abutment conformation, determining the area-capacity curve and a land rights map. The kelsh map also included the Grant Creek tributary and damsite.

A kelsh map was also made of the Black Rock reservoir site on the Little Luckiamute River above Falls City. A kelsh map of the cropland along Little Luckiamute from Falls City to the confluence with the Luckiamute River was also prepared for use in laying out the irrigation distribution system.

CHANNEL SURVEYS

Differential levels and cross sections were run on the major stream channels for use in computer flood flow analysis and to verify the flood plains shown by the geomorphology studies. Test data on channel bank soils was used in velocity studies.

IRRIGATION

Development of the irrigation program is based on data obtained from field measurements, streamflow and meteorological records, interviews with Soil Conservation Service and Extension Service staffs in Polk County, landowners and irrigators, and the State Watermaster and his deputies for the area.

Moisture holding capacity of the major soil groups was based on laboratory analysis of the same soils in other areas. Laboratory analyses obtained 1/3 and 15 atmosphere moisture contents and bulk density values. Moisture holding capacities of the other soil groups were estimates by soil scientists.

A survey of irrigation interest was taken by the Little Luckiamute Steering Committee which is now the Little Luckiamute Water Control District. A contribution of $1.00 per acre to be irrigated was requested to insure a firm signup. This survey resulted in a signup of approximately 3,400 acres. As a result of the signup and the anticipated demands, the Water Control District requested the project irrigated area be about 4,100 acres.

In addition to the primary area to be served, the Little Luckiamute Water Control District requested that a study be made of two areas north of the Falls City Highway, consisting of some 345 acres, to determine if it would be feasible to deliver water to them. This land is rather steep hill land and crops would be restricted to permanent pasture or hay. An analysis of this area showed that pumping costs would be excessive. Therefore, it was not included in the proposed project.

A pipeline distribution system serving 4,100 acres was prepared for cost estimating purposes. All the water is from storage in the Teal Creek Reservoir. It is recognized that the system may change when the actual irrigation contracts are let.

Preliminary layout was made on an aerial photo mosaic. This layout was then transferred to a Kelsh Plotted map of the area. Map scale was 1" = 400', and a contour interval of 10 feet with some 5-foot contours. The Kelsh Plotted map was the basis for designing the system. No additional field surveys were needed. The pipeline is mostly on private land.

MUNICIPAL AND INDUSTRIAL WATER

The cities of Monmouth, Dallas and Independence, the Luckiamute Domestic Water Association and Polk County were consulted to determine their present and projected water needs. Additional investigations for sources of municipal and industrial water on an area-wide basis have been prepared by private consulting firms at the request of the cities of Monmouth and Dallas and the Luckiamute Domestic Water Association. The reports indicate that the Little Luckiamute River Watershed Work Plan is compatible with the overall plans being developed for this region.

RECREATION

The Regional Park and Recreation Agency of the Mid-Willamette Valley has developed a comprehensive plan for intensive public recreational development of the Teal Creek Reservoir site. On-site investigations were made to determine facility feasibility with respect to topography, exposure, landscape adaptation, drawdown effect, and access. Consultation with appropriate Service personnel, sponsors and county officials were made to determine project needs, site potential, site utilization, and access and expected visitor day use.

Detailed comparison data was obtained from Lane County and the U. S. Army Corps of Engineers on recreation areas which are comparable in scope. These served as the basis for the projections.

FISH AND WILDLIFE

A number of meetings have been held with members of the state and Federal wildlife agencies to consider the alternatives for mitigation and enhancement of the fish and wildlife resources.

On-site visits have been made with representatives of state and Federal wildlife agencies. The state and Federal agencies have conducted independent studies and evaluations in the project area.

ECONOMICS

A damage survey was made in December 1968. Personal interviews were held with 27 farm operators. Information collected on this survey was used in determining crop and agricultural property damages.

County and state road officials were interviewed to obtain information about flood damages to public roads and bridges.

Utility damages occurred only during the extreme flood events (1964 flood) and were so minor that they were not used in the analysis. There was no commercial, industrial, or residential flood damage in the watershed.

Single enterprise crop budgets were used in determining net farm income per acre for the irrigation and land enhancement analysis. These budgets were also used in determining income losses and extra costs incurred when crops were damaged by floods.

Budgets were developed for a 530-acre farm typical of the larger farms in the watershed. Ownership costs of implements were derived from information supplied by the Water Control District and local implement dealers. Operating costs were obtained from technical publications and local sources. Implement costs for the cultural operations were obtained by weighing the several sizes of the same implement by the anticipated annual use of each size.

Budgets developed by the Willamette River Basin Survey were similar in size of implements to what would be used on the smaller farms in the watershed. These budgets were adjusted and used for a typical smaller farm unit of 100 acres.

Additional data regarding number of irrigations, stand lifes for perennial crops, fertilizer, pesticide and herbicide applications, taxes, labor rates, etc. were obtained from contacts with growers and the Extension Service. All prices and costs were converted to an adjusted normalized base.

Typical yields expected in the Little Luckiamute Watershed were established through contacts with local growers and from the experience of the SCS, ASCS, and Extension personnel. They are considered representative of what could be obtained using the management reflected in the budgets. The crop yields are consistent with the area and local technical guide data for the soils involved.

The methods and percentages used in calculating the secondary benefits were obtained from Chapter 11, "Economics Guide for Watershed Protection and Flood Prevention," SCS, March 1964. Secondary benefit estimates are based on the impact of project installation on the local economy. Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation and were not included in the benefit analysis.

ANALYSES

FLOOD PREVENTION

Area Flooded

The 100-year flood plain was delineated using the "Combination Method" as described in the American Society of Agricultural Engineers, Paper No. 68-232, "Methods of Identification and Mapping of Flood Plains" by Frank F. Reckendorf. The 100-year flood plain coupled with 15 surveyed full valley cross sections on the Little Luckiamute and water surface profile computations were the basis for developing areas flooded. To properly evaluate the flood plain area it was divided into ten evaluation reaches and they are as follows:

Reach	Identification
1	Little Luckiamute at Falls City to Southern Pacific railroad.
2	Waymire Creek
3	Little Luckiamute at Southern Pacific railroad to confluence with Teal Creek.
4	Teal Creek Site to confluence with Little Luckiamute.
5	Little Luckiamute at Teal Creek to Kings Valley Highway.
6	Upper Fern Creek to Guthrie School Road.
7	Fern Creek at Guthrie School Road to confluence with Little Luckiamute.
8	Little Luckiamute at Kings Valley Highway to downstream approximately one mile.
9	Little Luckiamute at foot of reach 8 to confluence with Cooper Hollow.
10	Little Luckiamute at Cooper Hollow to confluence with the Luckiamute River.

In those reaches where more than one valley section was surveyed a weighted average was taken to represent the reach.

The backwater effect of the Luckiamute River was considered and is included in the water surface profile computations. Area flooded versus percent chance of occurrence curves were developed for each reach and for each evaluation unit.

Peak Flow Studies

Peak flows were determined by 1) dividing the watershed into ten subareas; 2) estimating precipitation values from neary U.S. Weather Bureau rain gages for each subarea; 3) estimating runoff curve numbers for each subarea from land use and soils data; 4) estimating time of concentration for each subarea from ES-1015; 5) developing a 48-hour storm distribution from the December 1964 flood on the Luckiamute River near Haskins stream gage; and 6) by utilizing Soil Conservation Service Technical Release 20 computer program "Project Formulation Program - Hydrology" for flood routing. A peak discharge - frequency curve was developed within the watershed and the results were compared to recorded flows for the following stream gages:

Station	Number	Years of Record
Luckiamute River nr. Haskins	14-1895	34
Luckiamute River nr. Pedee	14-1900	28
Little Luckiamute River nr. Falls City	14-1901	3
Waymire Creek nr. Falls City	14-1902	15
Luckiamute River nr. Suver	14-1905	28

The TR-20 computer program was also used for evaluating several combinations of reservoirs for project conditions.

Floodwater Retarding Storage

Volume-duration-probability (VDP) data, developed by the Soil Conservation Service's Central Technical Unit, was used to determine the 1% chance of occurrence one and ten day inflow volumes for each structure site. Release rates for each site evaluated were determined from downstream conditions and desired levels of protection.

Studies were made on the Teal Creek Reservoir to determine if a single stage or a two stage principal spillway would provide the most effective control of flood flows. The Structure Site Analysis computer program was used for these studies and the results showed that the two stage inlet required less flood storage and provided greater reduction in peak discharges. The low stage release rate is approximately 20 csm and the high stage is about 100 csm, based on the Teal Creek drainage area of 9.83 square miles above the reservoir site.

Benefits

Information from the damage survey was used to compute per acre crop damages from infrequent and annual flooding. Crop damages were plotted at the 5%, 20%, 40%, and annual percent chance levels of occurrence and measurements made to obtain the without project average annual damages.

Remaining crop damages with the project were obtained by applying the per acre damages from infrequent events, weighted by the with project land use, to the average annual acres still flooding in each reach.

Agricultural property damages to farm roads and bridges, irrigation and drainage systems, fences; and including debris cleanup and sediment releveling were graphed and measured to obtain present average annual damages. Damages were reduced in proportion to the reduction in area flooded with a project.

Damages to public roads and bridges was predominately to county roads and bridges. Damages were projected to increase by 50% in 25 years to account for future improvements and developments. Discounted to present values, this meant an increase of 29 percent in present damage levels. Flood reduction will bring about $9,890 average annual benefits.

Restricted use of the flood plain is a major problem in the watershed now. Flood reduction will bring more intense land use benefits of $46,735 annually primarily from the higher cropping use of present pasture and hayland and the incorporation of fall instead of spring grain in rotations. Additionally, approximately 1,323 acres flooded so frequently that irrigation could not be accomplished without flood control. The benefits from conversion of dryland uses to irrigated crops were inseparable and resulted from both flood control and irrigation. Damages and benefits in this area were equally divided and $31,890 was assigned to restricted use for flood prevention.

IRRIGATION

Yield Analysis

The mean annual yield for the Teal Creek Reservoir was estimated from Hydrologic Investigations Atlas HA-274, "Patterns of Runoff in the Willamette Basin, Oregon", by Eugene A. Oster of the Geological Survey.

Yield Distribution

The streamflow records for the stream gage on Luckiamute River near Haskins, 14-1895, were used to determine the pattern of annual runoff.

Irrigated Areas

There are 6,528 acres of cropland in the irrigated service area in Little Luckiamute Valley and up Fern Valley to Guthrie School Road. Of this, 4,100 acres will be irrigated by the project. The remaining acres are either already irrigated or will remain in dryland use. Without project irrigation water, the service area will consist primarily of grain, pasture and modest amounts of row crops and specialty crops. With project water, most pasture would be irrigated and a pronounced shift to additional row crops and specialty crops would occur.

The use of the 6,528 acres of cropland in the service area with and without project irrigation water is:

Land Use	Per Acre Net Income	Percent of Area Without Project	Percent of Area With Project
Native Pasture	$ -2.80	9	-
Improved Pasture	13.50	18	2
Spring Barley	-4.25	2	-
Fall Wheat	56.85	53	18
Grass Seed	27.00	1	1
Idle	--	2	-
Irrigated Pasture	62.30	6	29
Corn, sweet	50.25	4	19
Beans, bush	146.20	1	14
Beans, pole	112.60	1/	1
Mint	193.00	1	4
Red Clover	94.55	3	8
Sugar Beet Seed	287.70	1/	2
Strawberries	221.70	1/	2
		100	100
Total Income		$297,850	$560,275
Weighted per acre income		$45.63	$85.83

1/ Less than 1 percent

The increase in weighted per acre net income is $40.20. Associated costs of land clearing, systems and drainage amounted to a total of $71,480 or $10.95 per acre on an annual basis. The weighted per acre income of $40.20 less the associated costs of $10.95 per acre results in a net annual benefit of $29.25 per acre. The average annual irrigation benefits are, therefore, $29.25 x 6528 = $190,945. Of the $190,945, $31,890 was allocated to flood prevention because both flood prevention and irrigation were necessary to achieve the benefits in the more frequently flooded areas. The resulting average annual irrigation benefits are, therefore, $190,945 less $31,890 or $159,055.

Net Irrigation Requirements

Consumptive use values for all crops (except strawberries) were completed by methods outlined in SCS TR-21. Weather records used were those for the Dallas weather station. Thirty-two years of record were available. Water needs for strawberies were based on an analysis of present irrigation practice along the Little Luckiamute River.

Average growing season rainfall values were reduced to 80 percent values by statistical methods outlined in SCS TR-21. These values were then reduced to "effective" rainfall by methods outlined in SCS TR-21 to compute the net irrigation requirement.

Winter rainfall effectiveness was assumed to be adequate to bring the soil moisture in the root zone depth of the profile up to field capacity at the beginning of the growing season for all crops.

The average project depletion of soil moisture storage at the end of the crop growing season was assumed equal to one-half the available soil moisture storage capacity (except corn and bush beans planted after June 1). This depletion amount was divided equally between the beginning and end of the crop growing season to represent average project soil moisture carryover conditions.

Plantings of corn and bush beans, after June 1, will be preirrigated. The project 80 percent net irrigation requirement, weighted for crops and soils, is 12.20 inches for the 4,100 acres to be irrigated from the project.

Peak Use Rate

The peak period consumptive use rate used in design of the system was computed by methods outlined in SCS TR-21.

Efficiencies

The transportation of water from the Teal Creek Reservoir to the project irrigation area will be by means of a buried, pressurized pipeline system to on-farm delivery points. There will be no transportation losses, and it is expected that, on a project basis, an application efficiency of 65 percent can be maintained.

Recovery Factor

There is no direct loss to natural channels under sprinkler irrigation and return flow, if any, would be very small. No allowance was, therefore, made for waste water recovery.

Existing Water Rights

Existing water rights will be fully honored to the extent that natural streamflow is available. All natural streamflow required by prior rights for beneficial use below the reservoir will be passed through the reservoir from May 1 to October 1 each year.

Benefit Analysis

Primary Benefits - The irrigation benefit analysis is based on providing water to fully irrigate 4,100 acres with a reliability of providing a full supply 80 percent of the years. Weighted average net return per acre, with and without the project, was determined using the crop budgets, yields, and cropping patterns developed for this area. Costs of associated land treatment measures and additional operation and maintenance due to installation of these measures were deducted to obtain net project benefits. (See page 90 for a tabulation of the benefits by irrigation area.)

MUNICIPAL AND INDUSTRIAL WATER

Based on analysis of prior water quality tests from Teal Creek and the fact that the City of Monmouth has been using Teal Creek water for many years, water can be treated at a reasonable cost and is adequate for M & I use. The following are the results of a sample tested by the Oregon State Department of Environmental Quality in December 1968:

Test	mg/l	Test	mg/l
Color	2.	Conductance (mc mho/cm)	27.
Turbidity	5.		
Solids, Total	37.	Chlorides	2.2
Solids, Valatile	24.	Sodium	2.4
Carbon Dioxide	9.0	Potassium	0.1
pH	6.3	Fluoride	0.01
Alkalinity, Total as $CaCO_3$	8.	Phosphates (soluble Ortho)	0.03
Hardness as $CaCO_3$	6.0	Sulfates	3.0
Calcium	2.1	Silicon	11.5
Magnesium	0.2	Aluminum	0.05
Total dron	0.09	Nitrogen, Amononia	0.49
Manganese	0.01	Nitrogen, Nitrite	0.03
Arsenic	0.005	Nitrogen, Nitrate	0.04
Lithium	0.1		

Monmouth has also reviewed its demands and the proposed operation schedule for the Teal Creek Reservoir and has agreed that it meets the peak demand and monthly requirements they have set forth for the M&I water.

The results of an M&I water source study prepared for the City of Monmouth by a private consulting firm showed Teal Creek Reservoir as one of two sources that could be developed to provide an adequate supply of water. The study also showed that the reservoir is located so as to fit in with the existing M&I distribution system.

The benefit analysis for municipal and industrial water supply is on the basis of the least costly alternative for supplying water. The following two studies were used in this analysis:

1. "Water for Monmouth" by Clark and Groff Engineers, Inc., Salem, Oregon, January 1967.

2. An engineering report on the Dallas water system by Cornell, Howland, Hayes and Merryfield (CH_2M), March 1966. An updating of this study was made in February 1970 by CH_2M and entitled, "A Preliminary Concept Review."

RECREATION

The recreation facility designs are based upon analyses of local and adjacent recreation population pressure, site adaptation potential and sponsor capability. Based upon a comparison with other similar developments, it is designed for an annual use load of 420,000 visitor days initially with a daily peak use load of 6,600 visitors.

Analyses of local recreation is oriented toward picnics, camping, boating, watersports, fishing, playground athletics, and nature studies. The population within 50 miles of the watershed exceeds 300,000. At present there are few reservoir-based recreation areas serving this population area. The comparison with similar existing areas in the valley and their experienced visitation was used to determine the expected recreational usage.

Without exception recent area planning recommendations specifically emphasize the need for recreational developments within the watershed area.

The recreation benefits were determined by using the maximum allowable benefit of $1.50 per visitor day since the recreation facilities will be fully developed. The use of 420,000 visitor

days will provide a total average annual recreation benefit estimated to be $630,000.

FISH AND WILDLIFE

In consultation with the U. S. Fish and Wildlife Service and the Oregon State Fishery Agencies the needs for anadromous fish passage at Teal Creek Reservoir were determined. It was agreed that a maximum of 170 coho salmon and 170 steelhead needed passage to areas above the damsite. Mitigative measures to trap and haul these fish were designed for the site.

Downstream passage was also considered for the young salmon and steelhead moving out of the reservoir in early spring. Spillway design features will provide for this passage.

The Fish Commission of Oregon reviewed the opportunities for fisheries enhancement. They have determined that through the proper operation of Teal Creek Reservoir and the addition of six incubator trays at a suitable site, an additional run of about 500 fall chinook salmon could be established. The eggs taken from the adult salmon will be hatched in the incubator trays and the resulting fry will be placed in the reservoir where they will grow to migrating size and allowed to leave the reservoir via the flood gates and spillway.

The annual benefits of this new run would be 31,500 pounds commercially caught at $0.56 a pound or $17,460 annually, and 3,750 angler days at $6.00 a day or $22,500 annually to the sport fishery. These fish would be caught in the Pacific Ocean, Columbia and Willamette River. If fall chinook salmon were not available, another species of salmon would be used with a similar value.

STRUCTURAL MEASURES

BASIS FOR STRUCTURAL DESIGN

Design Hydrographs

The structure classification of the reservoirs was established by the State Conservation Engineer. The criteria used is in the Watershed Protection Handbook and Engineering Memorandum SCS-27 (Rev.), "Earth Dams".

The principal spillway hydrographs were developed using VDP data and the appropriate dimensionless mass curves in Chapter 21, NEH-4.

Emergency spillway design and freeboard hydrographs were developed for the 6 and 24 hour Type I storm and the 48 and 72 hour duration storm from the USWB Hydrometeorological Report #43. A study using the structure site analysis computer program indicated that the 72 hour duration storm was the critical design storm according to the criteria in Engineering Memorandum SCS-27 (Rev.). Design routings were started at the crest of the emergency spillway for the Teal Creek Reservoir.

Joint Use Studies

Analysis of the available streamflow and climatological records indicated that 100 percent joint use of the floodwater retarding storage with irrigation and municipal and industrial water supply storage was possible for the Teal Creek Reservoir Site. Operation schedules proposed by other agencies in the Willamette Basin, indicated that the allocation of the joint use storage could be done on a fixed time basis rather than on a forecast basis.

The proposed allocation schedule for the floodwater retarding storage in Teal Creek Reservoir is as follows: 8,800 acre feet available from September 1 through March 1, and none available after June 1. On March 1 the flood gates on the spillway will be closed to permit the filling of the retarding storage area. The rate of filling will depend on the occurrence of the spring runoff. However, some retarding storage will be available until the reservoir is full, on approximately June 1. The flood gates will not be opened until the reservoir has been drawn down by 8,800 acre feet, which should occur by September 1.

Analysis showed that with mismanagement or unusual storm timing and the proposed allocation schedules, the flood prevention benefits would not be jeopardized. Reservoir operation studies are based on an analysis of stream gaging data on the Luckiamute River and showed that the proposed schedules for allocation of floodwater retarding storage are technically feasible and the proposed demand schedule will be met at least 8 out of 10 years.

Teal Creek Reservoir

The preliminary plans for the Teal Creek Reservoir are based on a homogeneous earth fill structure with a vertical drain in the downstream section. The dam was planned using criteria for a class "C" structure.

The embankment design is based on foundation conditions and maximum use of available fill material.

The borrow area lying between the maximum and minimum pools will be shaped after removal of embankment material to prevent formation of isolated pools in which fish could be stranded during reservoir drawdown.

The emergency spillway will be located on the left abutment and will have the capacity to discharge the routed freeboard hydrograph storm. It will consist of a box-inlet concrete chute spillway with a SAF basin.

The capacity of the box-inlet, chute and SAF basin was determined by routing the emergency spillway and freeboard hydrographs by the storage-indication method as outlined in SCS-NEH-Section 4. The dimensions of the components of the chute spillway were determined by procedures outlined in SCS-NEH-Section 14.

Consideration was given to an earth spillway but soil conditions limited permissible velocities and would have required the concrete lining of the spillway. The planned structure was determined to be the most desirable for the existing conditions.

Wave freeboard was computed using Stephenson's Equation and was checked with criteria presented in the U. S. Bureau of Reclamation publication, "Design of Small Dams".

Two gated orificies are planned on the front of the box-inlet. These will take the place of a principal spillway and will regulate the flood flows during the flood season. The lowest orifice is planned to be closed on March 1 and the highest orifice is to be closed on April 1 to permit the filling of the reservoir for irrigation and municipal and industrial water supply purposes. In addition to the gated orifices there will also be located two gated ports on the box-inlet to permit passage of anadromous fish through the reservoir after the orifices have been closed for the filling of the reservoir. One port will be located at the crest of the flood pool and will be left open until water fills up to the second port which will be located at the crest of the high stage or second orifice. When the water reaches the second port, the first one will be closed. When the reservoir is full, then the second port will be closed and then any fish passage will be over the crest of the emergency spillway.

After the storage has been drawn down to the crest of the flood pool, the gated orifices will be opened until March 1 of the next year.

Operation Studies

Operation studies were made for the Teal Creek Reservoir. It was assumed that the recreation pool was at its minimum level and could be used as the starting elevation.

The average monthly evaporation rates were computed using data from the Corps of Engineers Fern Ridge Reservoir near Eugene, Oregon. The average monthly precipitation was determined using U. S. Weather Bureau data. The monthly precipitation values were subtracted from the evaporation rate figures to determine net monthly evaporation rates.

The annual distribution of the municipal and industrial water supply is based on discussions with the City Manager of Monmouth and their projections for future use.

Operations studies were checked by an operation schedule similar to that set forth in SCS TR-19. Several assumptions as to irrigated area and M&I demand were tried for the Teal Creek Reservoir and checked against estimated yields to determine reliability. These studies indicated that the yield into Teal Creek Reservoir, including the water diverted from the Little Luckiamute, is sufficient to meet the demands and needs in the watershed. The annual runoff from Teal Creek alone is sufficient to fill the reservoir for recreation and fish enhancement needs.

Irrigation Pipelines

Pipeline capacity is based on the project peak period use rate with continuous 24-hour per day irrigation during the peak period. The pipelines were designed to provide a delivery of water at a minimum pressure of 50 psi.

Diversion System

Diversion Dam

The preliminary plans are based on a straight inlet drop spillway being constructed across Little Luckiamute with a gated orifice in the front of the spillway to create a small pool in which flows will be diverted into the diversion canal. Consideration was given to several other types of overflow structures but the straight inlet spillway was determined to be the most desirable for the existing conditions.

It is planned to pass 500 cfs down the Little Luckiamute before any flow will be diverted into the diversion canal during the flood season. Consideration was given to passing smaller and larger amounts

down Little Luckiamute before diverting into the diversion canal. The passing of smaller flows, before diverting, would have increased the flood storage requirements without any increase in benefits. The passing of larger flows, before diverting, would have decreased the flood storage required but also decreased the flood benefits.

By gating the orifice on the front of the diversion dam it is possible to utilize runoff from Little Luckiamute to help fill Teal Creek Reservoir during April and May. This provided a more reliable yield and also permitted a later date for filling the flood storage pool. As a result of this, it is a more desirable operation and also enchances the operations of the reservoir for flood prevention benefits

Diversion Canal

The preliminary plans are based on a concrete lined canal being constructed from the diversion dam, across Little Luckiamute, and extending about 7,354 feet adjacent to Little Luckiamute, through portions of Falls City and through the ridge between the Little Luckiamute and Teal Creek drainage areas, into the Teal Creek Reservoir. Consideration was given to an earth lined canal but due to the location of the canal, topography, required capacity and velocities the concrete canal was selected as the most feasible alternative.

The inlet of the diversion canal is planned for a capacity of 2,000 cfs. Three-hundred twenty feet downstream from the inlet 800 cfs is planned to be returned to Little Luckiamute by means of a side weir and flume structure. This will insure a diversion of 1,200 cfs into the Teal Creek Reservoir. Consideration was given to diverting less than 1,200 cfs and more than 1,200 cfs. Smaller diversion flows reduced the flood benefits and larger flows increased the flood storage required with some increase in flood benefits. The planned capacity was determined to be the most desirable with the least amount of storage for the largest amount of benefits.

The canal is also planned to be used to help fill the flood storage area in Teal Creek Reservoir during April and May. A maximum of 150 cfs is planned to be diverted and, coupled with the Teal Creek runoff, is sufficient to fill the reservoir.

COST ESTIMATES FOR STRUCTURAL MEASURES

Cost estimates for structural measures are based on the preliminary design for each measure and reflect current prices for similar work in the locality. Where local information was not available, costs

for similar construction in other areas were used with appropriate adjustment for local conditions by analysis of production rates, cost for equipment, availability of material, accessibility, topography of the site, and size of the structure.

Data for cost estimates for road relocation was obtained from the Polk County Highway Department.

Contingencies up to 30 percent were added for each construction cost item depending on the complexity of the item and the possibility of unforeseen costs. The average contingency for all structural items is 20 percent.

ALTERNATIVE RESERVOIR SITES STUDIED

Grant Creek

A reservoir site was studied on Grant Creek a short distance upstream from the confluence with Teal Creek. The dam would only be about 700 feet across and could store 5,000 acre feet. However, it only controls a drainage area of 3.0 square miles and would have little effect for flood control.

As demands for water in Polk County increase, this site could be used to help meet these demands.

Lower Teal Creek

A reservoir site was studied on Lower Teal Creek, which would have controlled the drainage area from Grant Creek in addition to Teal Creek. The sponsors wanted to protect the Grant Creek site for future development, and this site would have not permitted that. Since the needs could be served from the proposed site, this site was then deleted from further consideration.

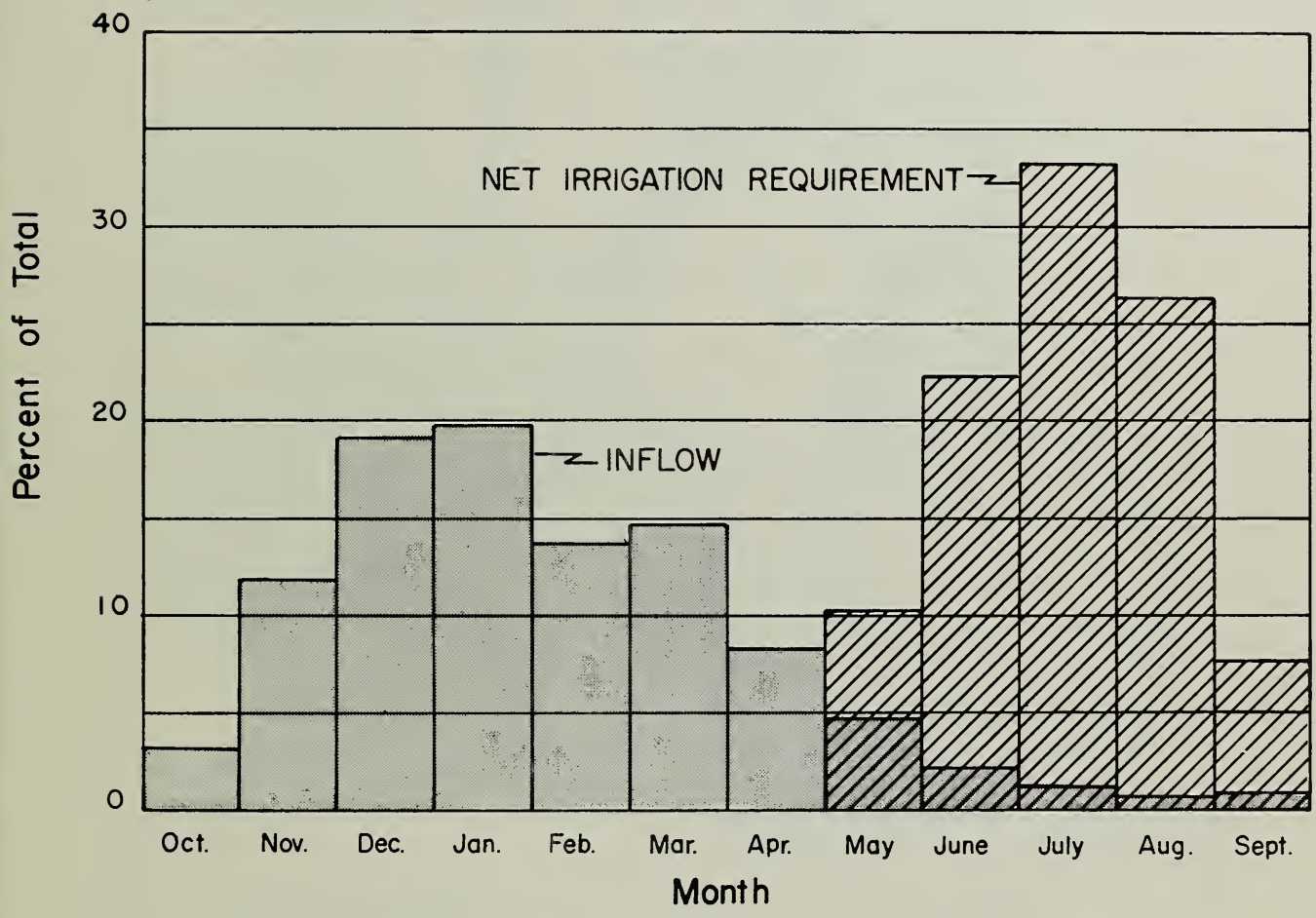
Black Rock Reservoir

A reservoir site was studied at Black Rock on the Little Luckiamute River upstream from Falls City. It would have controlled 17.85 square miles and provided a higher level of flood protection. However, the site had a small storage basin and required a large dam for the amount of flood storage needed. Also there are a number of slide areas and potential slide areas above the damsite and these would have created a hazard to the safety of the dam.

Figure 1

LITTLE LUCKIAMUTE RIVER WATERSHED

AVERAGE ANNUAL RUNOFF AT TEAL CREEK DAM SITE AND NET IRRIGATION REQUIREMENT



LOCATION MAP

LEGEND

Upland hill an mauntain sails. Used primarily far caniferaus farests. Typical series – HEMBRE & PEAVINE.

Faathill sails. Used primarily far waadland, pasture, and same field craps. Typical series - JORY, STEIWER, & WILLAKENZIE.

Battamland and terrace sails. Used primarily far pasture, hay, specialty, and raw craps. Typical series - CHEHALIS, McBEE, & WAPATO.

SCALE IN MILES
1:96,000

FIGURE 2
WORK PLAN

SOILS AND LAND USE MAP
LITTLE LUCKIAMUTE RIVER WATERSHED

POLK COUNTY, OREGON

PRELIMINARY PLANS

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

Prepared by M. J. Date 2/70 Approved by T. W. Date 2/1977

USDA-SCS-PORTLAND, OREG. 1970

2660 Feet to Diversion from Little Luckiamute River

N

Scale in Feet
500 0 500 1000 1500
1:12,000
Contour Interval 20 Feet
T 8 S R. 6 W W.M.

Top of Dam Elev = 4007' M.S.L.
Maximum Water Surface Elev = 3991' M.S.L.
Storage Pool Elev = 3951' M.S.L.
Recreation Pool Elev = 3895' M.S.L.

Diversion Canal
To Falls City
Road Relocation
CITY LIMITS
City Meadow
Falls
Swimming Beach
Boat Ramp
Parking
Teal Crest Park
Picnicking
Parking
Picnicking
20 21 29 28
Killowan
Parkway
Boughey
Creek
Teal
340
360
380
400
320
Boat Dock
Picnicking
Trails & Nature
Timber
Approximate Take Line
Hills
Trails & Nature
Teal Creek
King Ranch
Gravel Creek
Overnight Camping

LEGEND

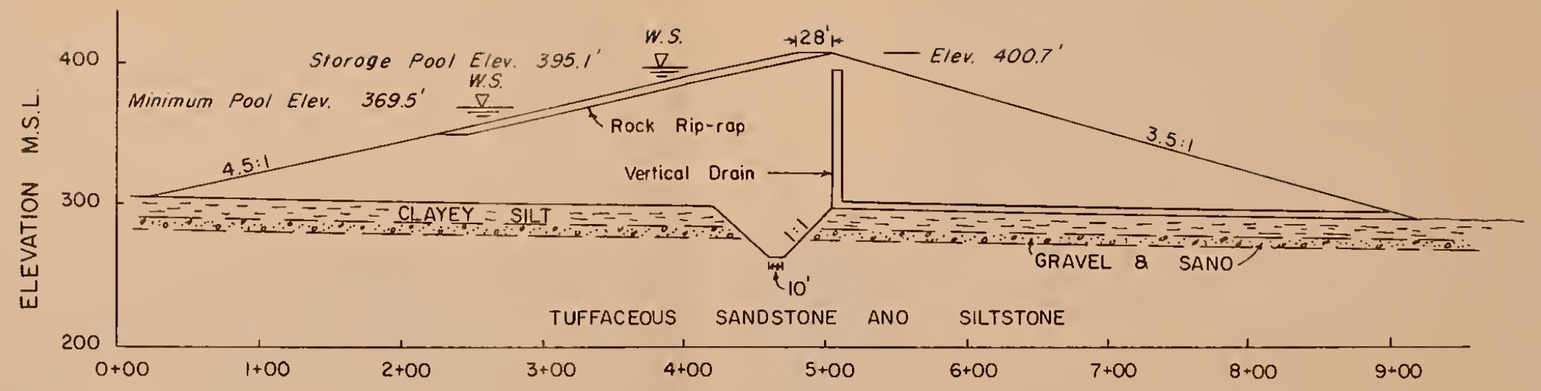
- Recreation Pool
- Storage Pool
- Pumping Plant & Fish Facility
- Pipe Drain & Irrigation Outlet
- Rest Rooms
- Bath House
- Diversion Canal
- Road Relocation & or Park Road
- [R] Regulating Reservoir

FIGURE 3
WORK PLAN

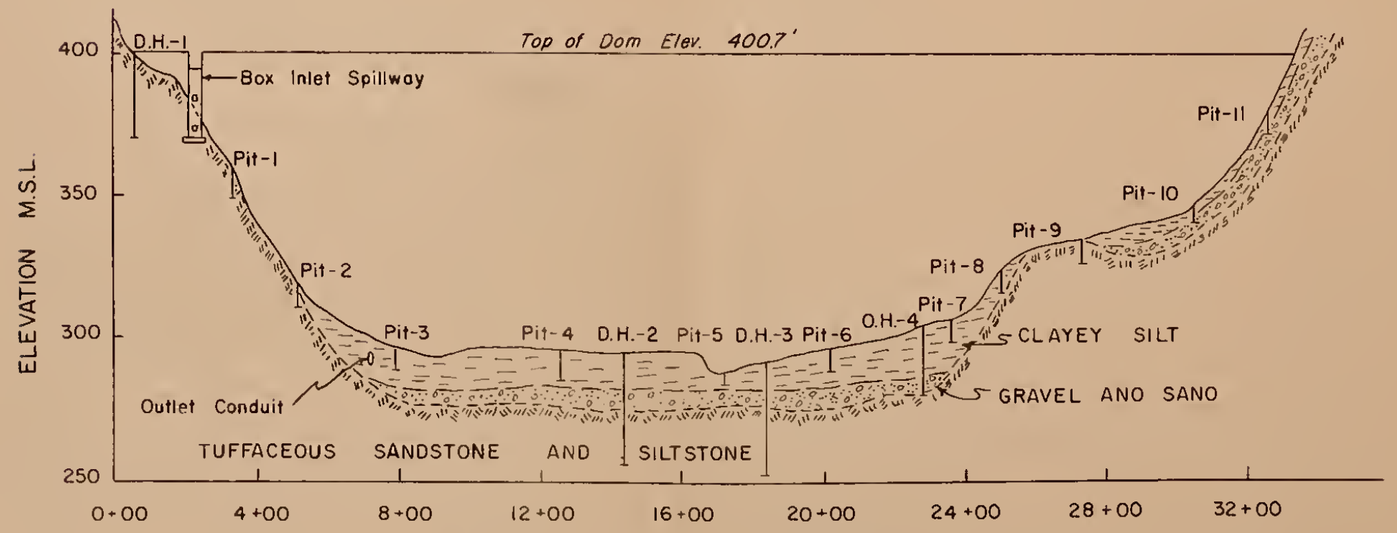
TEAL CREEK RESERVOIR AND RECREATION DEVELOPMENT

LITTLE LUCKIAMUTE RIVER WATERSHED
POLK COUNTY, OREGON
PRELIMINARY PLANS
U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

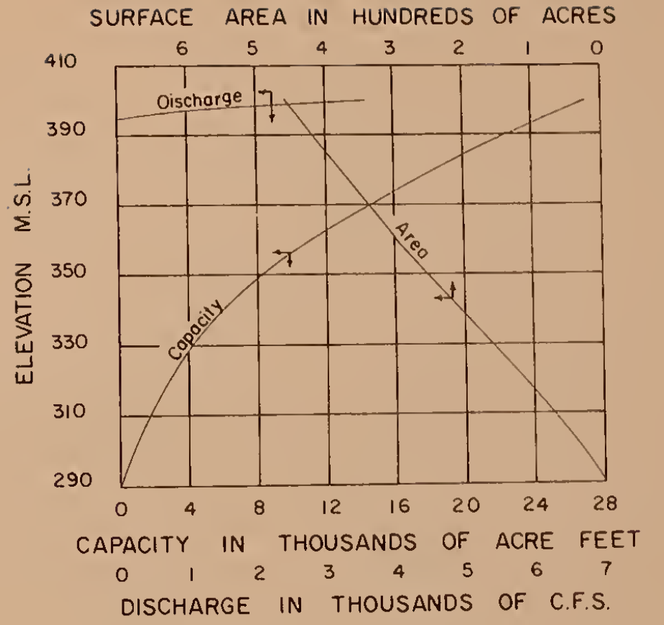
Prepared by WRS-ORE-1170 Date May 1970 Drwg No M7-E-21479-N
Revised Oct 1970



TYPICAL SECTION OF HOMOGENEOUS FILL



℄ PROFILE OF DAM



AREA, CAPACITY, DISCHARGE CURVES

FIGURE 4

WORK PLAN

TEAL CREEK DAM

AND GEOLOGY

LITTLE LUCKIAMUTE RIVER WATERSHED

POLK COUNTY, OREGON

PRELIMINARY PLANS

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Prepared by KMC Date Feb. '70 Orwg. No. 7-N-21502

USDA SCS-PORTLAND, OREG. 1970

FIGURE 5

WORK PLAN

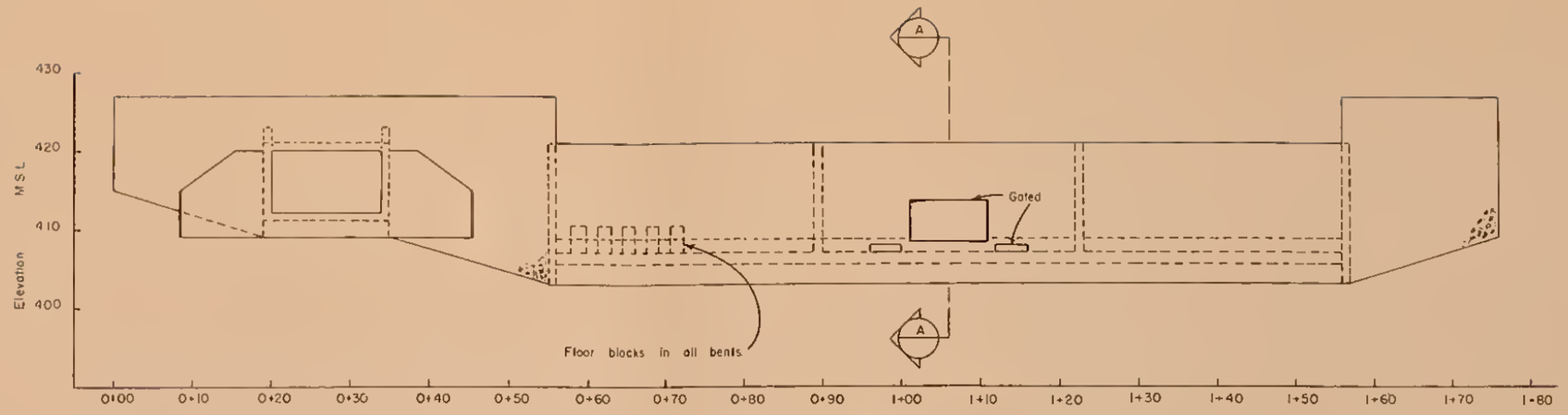
IRRIGATION WATER DISTRIBUTION SYSTEM

LITTLE LUCKIAMUTE RIVER WATERSHED
POLK COUNTY, OREGON

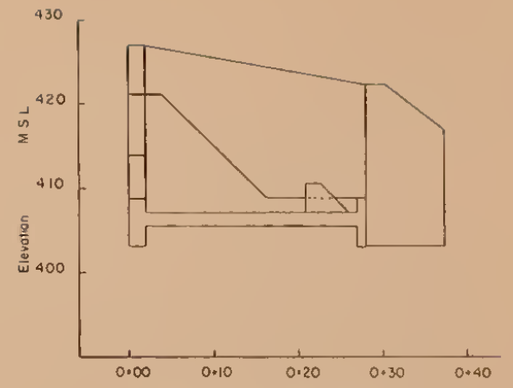
PRELIMINARY PLANS

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

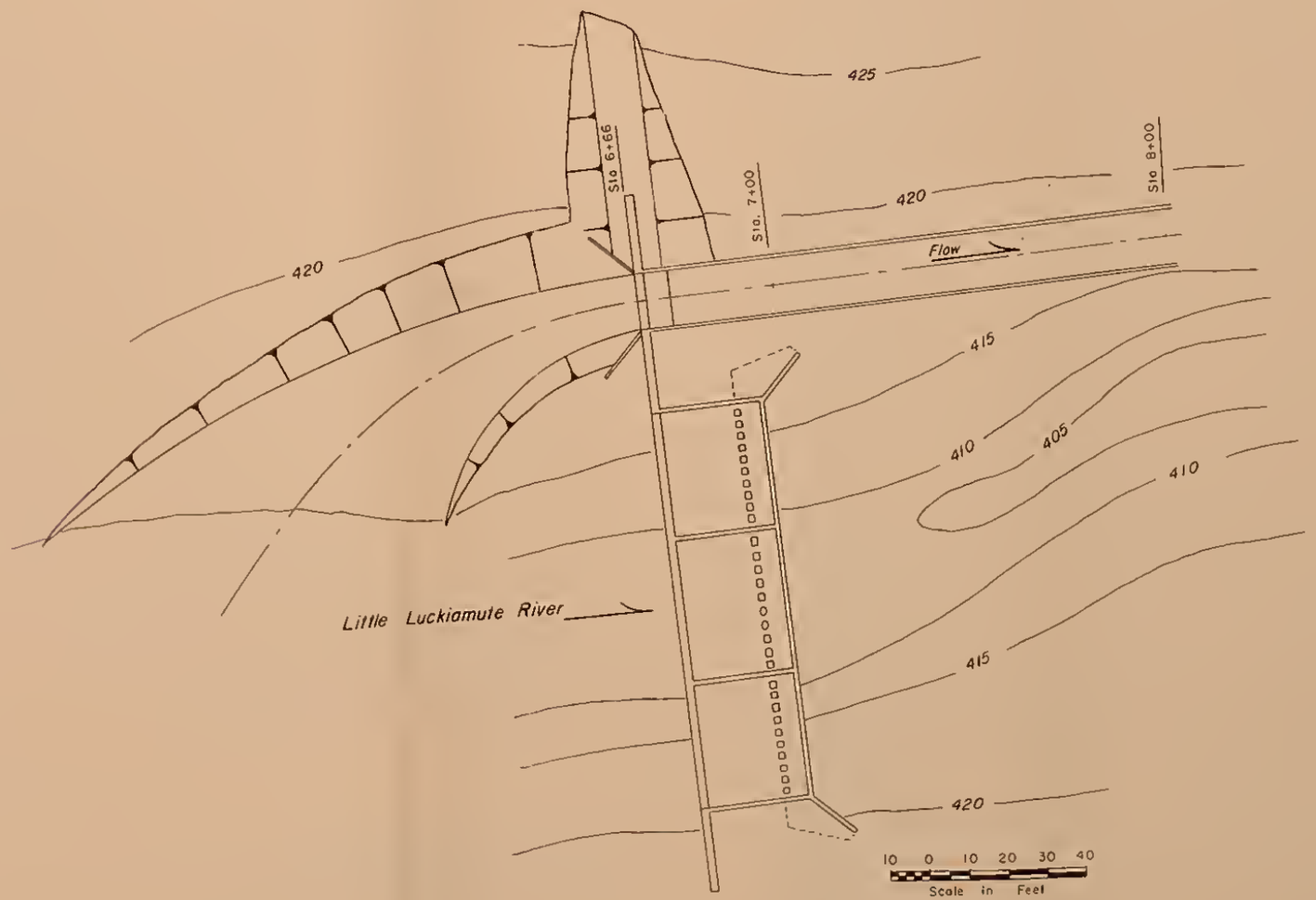
Date Feb. 70 Drwg. No. M7-N-21468



FRONT VIEW (Upstream)



SECTION THROUGH A-A



PLAN VIEW

FIGURE 6

WORK PLAN

LITTLE LUCKIAMUTE RIVER DIVERSION SYSTEM

LITTLE LUCKIAMUTE RIVER WATERSHED

POLK COUNTY, OREGON

PRELIMINARY PLANS

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Prepared by rol-ldp Date March 1970 Drwg No MT-E-21545-N

R. 7 W.

R 6 W

R. 5 W.

123° 30'

123° 20'

44° 50'

T 8 S

T. 9 S

Fanno Pk.

Little Luckiamute River

Black Butte Cr.

Sams Cr.

Lucktamute River

Berry Cr.

Boughey Cr.

D.A. 40.17 sq. mi.

North Fk

South Fk

Teal Cr.

F,I,R,M

TEAL CREEK RESVR.

Burns Corner

Grant Cr.

Wormick Cr.

FALLS CITY

LITTLE

Fora Cr.

VALLEY

HIGHWAY S.P.

KINGS

Hoffman

Cooper

LUCKIAMUTE

RIVER

LUCKIAMUTE RIVER

LEGEND

Multiple Purpose Structure
- F – Flood Prevention
- I – Irrigotion
- R – Recreotion, Fish ond Wildlife
- M – Municipol Industriol

Diversion System

Areo Benefited

Droinoge Areo Controlled by Structure

See Figure No. 6 for Irrigotion Woter Distribution System

Little Luckiomute River Watershed

OREGON

LOCATION MAP

0 1 2 MILES

SCALE 1:96,000

WORK PLAN

PROJECT MAP

LITTLE LUCKIAMUTE RIVER WATERSHED

POLK COUNTY, OREGON

PRELIMINARY PLANS

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

Approved by USDA June 6/70 — MT-N-21499

USDA-SCS-PORTLAND, OREG. 1970